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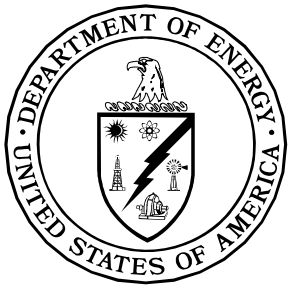
RISK-BASED END STATE VISION



Fernald Closure Project
February 20, 2004
Revision 2

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EXECUTIVE SUMMARY

This document provides a description of the Risk-Based End State (RBES) Vision for the U.S. Department of Energy (DOE) Fernald Closure Project (FCP). The purpose of the RBES document is to effectively communicate the RBES Vision of the FCP site to Regulators, DOE Headquarters (HQ), and Stakeholders.

DOE Policy 455.1, **Use of Risk-Based End States**, was issued in July 2003 as a follow-up to DOE's 2002 Top-to-Bottom Review**.** The intent of the policy is to ensure that DOE's nationwide cleanup effort is driven by clearly defined, risk-based end states, particularly for those sites that do not yet have cleanup agreements in place.

The DOE guidance document, *Guidance for Developing a Risk-Based, Site-Specific End State Vision,* was also released in July 2003 and finalized in September. The FCP has prepared this document as a deliverable in accordance with the guidance. The guidance addresses both the sites that have formal cleanup plans already in place (like Fernald), as well as those sites that do not yet have formal agency-approved Records of Decision.

Briefly, the guidance calls for each site's Vision to initially include ***all*** technically supportable, risk-based opportunities for consideration. From there, a short-listing of opportunities for further consideration is to be formulated. Note that Fernald is currently at the initial stage of risk-based opportunity identification; therefore, no short-listing has yet been conducted.

For sites that have formal cleanup agreements in place, the initial Vision "brainstorming" is not to be limited by the constraints of the cleanup agreements. Rather, at this stage of the process, the brainstorming of ideas is to consider all technically supportable possibilities, regardless of current agreement requirements. It is important to note that the RBES is not a decision document and is being developed pursuant to the DOE guidance document to identify opportunities.

The short-listing process will then include consideration of the existing cleanup agreements, and the potential need for (and benefit of) modifications to existing agreements. Again, this short-listing is to be done as a second step in full consultation with Stakeholders and Regulators. Note that in order to accommodate current agreement requirements, the guidance calls for the identification of "Variances" between current agreements and the RBES Vision.

In its response to the Assistant Secretary for Environmental Management's (EM) Top-to-Bottom Review, the Fernald team outlined an aggressive approach to satisfying each of the six major recommendations carried forward from the review. Fernald's response reaffirmed the team's strategy and execution approach to achieve accelerated site closure in 2006, and outlined the needed support from DOE-HQ and Congress to achieve the 2006 objective. The aggressive acceleration actions contained in the Fernald team's response have been carried forward to the Performance Management Plan (PMP).

Prior to the development of initiatives in response to the Top-to-Bottom Review, Fernald's Performance Measurement Baseline called for closure in 2009. Fernald is implementing reform initiatives that reduce project risk and achieve closure three years earlier in 2006. Acceleration of closure carries the obvious benefit of earlier reduction of risk associated with Fernald contamination.

The Fernald site consists of a land area of 1,050 acres with about 140 acres dedicated to the original production facility buildings, and 37 acres dedicated to the historical waste storage areas (the waste pits and silos). The site is near Ross, Ohio, a farming community located about 20 miles northwest of Cincinnati. The prevailing land use surrounding the facility is residential/farming, with light industrial and commercial activities nearby.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial investigations and feasibility studies have been completed for each of the five operable units (OUs). Final Records of Decision (RODs) to establish cleanup levels and document the cleanup remedies have been signed for each OU by DOE, U.S. Environmental Protection Agency (EPA), and Ohio EPA.

One of the requirements of the 2003 Fernald Closure Contract Modification Number M038 is the need to identify the most cost-effective groundwater infrastructure to remain at the site when the other baseline work elements defining Site Closure are complete at the end of June 2006. While technically not a RBES Vision opportunity (since the full restoration of the Great Miami Aquifer will occur to the same end state sometime after 2006 regardless of the treatment/infrastructure decisions being contemplated under Modification M038) Fernald is engaged with the FCAB and the Regulatory Agencies regarding the possibilities and options for the D&D of groundwater treatment infrastructure in time for the resultant surface and subsurface soil and debris to be placed into the OSDF before that facility permanently closes.

The projected final land use of the FCP site is an Undeveloped Park with limited public access to the site. Risk evaluations, conducted for each of the OUs of the FCP per EPA guidance, used the Undeveloped Park as the projected final use of the FCP. The Recreational User was the primary receptor used to establish cleanup levels at the site.

An Environmental Assessment (EA) was prepared in 1998 to finalize the land use decision for the FCP (DOE, 1999b). The EA proposed that more than 900 acres of the site be restored and dedicated as an Undeveloped Park. The EA also proposed a 23-acre portion of the FCP that may be considered for development to support community needs and restated the commitment of the approximately 75-acre area that would remain dedicated to the On-Site Disposal Facility (OSDF). Public review of the EA supported the proposed land use of the FCP and the land use decision was documented in a Finding of No Significant Impact (FONSI) issued in June 1999.

The future mission for Fernald will be Legacy Management of the areas of concern left on site. The decisions concerning the final list of hazard areas and any s to be left on site, will be evaluated collaboratively with the participation of the Fernald Citizen's Advisory Board (FCAB), EPA, and Ohio EPA. Both the FCAB and the Regulators have strongly pointed out that the risk-based decisions already reached for the site to arrive at the original cleanup remedies in the RODs have produced a solid "RBES Vision" for Fernald that requires little further tailoring.

During October 2003, initial meetings were held with the FCAB and the Regulatory Agencies to identify issues of concern with the changes that may be contemplated under the RBES Vision. It was clear from the initial interactions that the FCAB and the Regulators are not amenable to changes in groundwater cleanup levels, surface water discharge limits, or other changes that significantly increase residual contamination following remediation, or releases during the process. The FCAB and agencies also raised concerns that the RBES process could create distractions and resource demands that ultimately detract from achieving the 2006 closure schedule if not managed wisely, considering the progress of remediation already being made in the field.

Provided Fernald's end state remains health and environmentally protective at levels consistent with the existing RODs, the participants are willing to consider new benefit-seeking initiatives through the RBES process that remain consistent with the 2006 schedule.

The FCP is a 2006 Accelerated Completion Site with an approved PMP. The RBES Guidance requires only the RBES associated maps, conceptual site models (CSM), and narratives; therefore, no current state information is provided in this document.

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ACRONYMS

AWWT	Advanced Wastewater Treatment
BTV	Benchmark Toxicity Value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COEC	Constituent of Ecological Concern
CPRG	Cross-Media Preliminary Remediation Goals
CSM	Conceptual Site Models
D&D	decontamination and dismantlement
DOE	Department of Energy
EA	Environmental Assessment
EM	Environmental Management
EPA	Environmental Protection Agency
FCAB	Fernald Citizen's Advisory Board
FCP	Fernald Closure Project
FONSI	Finding of No Significant Impact
FRESH	Fernald Residents for Environment, Safety and Health
FRL	Final Remediation Level
HDPE	High-Density Polyethylene
HI	Hazard Index
HQ	Headquarters
IAWWT	Interim Advanced Wastewater Treatment
ILCR	Incremental Lifetime Cancer Risk
NPDES	National Pollution Discharge Elimination System
OSDF	On-Site Disposal Facility
OU	operable unit
PMP	Performance Management Plan
RBES	Risk-Based End State
RCRA	Resource Conservation and Recovery Act
RIMIA	Receiving & Incoming Material Inspection Area
ROD	Record of Decision
SEP	Sitewide Excavation Plan
SERA	Sitewide Ecological Risk Assessment
SPIT	South Plume Interim Treatment Facility
SSOD	Storm Sewer Outfall Ditch
TTA	Tank Transfer Area
WAC	waste acceptance criteria

UNITS

cfs	cubic feet per second
gpm	gallons per minute
ppb	parts per billion
ppm	parts per million

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1.0 INTRODUCTION

1.1 ORGANIZATION OF THE REPORT

This report describes the FCP site mission, cleanup program, and the RBES Vision for the regional context, the site context, and the hazard specific areas. The RBES document is divided into four major sections. Section 1 has provided an executive analysis of the FCP RBES Vision and a summary of the FCP site mission (past, present, and future), the status of the FCP cleanup program, and decision-making context. Section 2 describes the Regional Context RBES, Section 3 describes the Site Specific RBES, and Section 4 provides summaries of the specific hazards associated with the RBES for the FCP. Attached to the RBES Vision document is the Variance Report that summarizes the differences between the current agreements for Fernald's end state and the RBES Vision and several key Fernald RBES press articles.

The RBES Vision for the FCP will be depicted through maps, conceptual site models (CSM), and narratives. The RBES Guidance requires only the RBES associated maps, CSM, and narratives; therefore, no current state information in provided in this document. The RBES maps for the Regional Context, Site Context, and Hazard Specific Areas for the FCP are provided in this document and are described below. The setting for the RBES maps is the point in time when final land use is achieved and all long-term stewardship activities are in place, i.e., at the time of site closure. In addition, the RBES maps enable the graphical depiction of the hazards, their associated risks, and the affected populations or receptors.

The Regional Context maps place the FCP site within the context of southwestern Ohio. The Site Context maps encompass the FCP site and the lands immediately adjacent to the site. The Hazard Specific maps provide the most detail of the areas of the FCP site that contain hazards that may present risks to human health or the environment.

CSM are intended to communicate risk information to DOE managers, the regulatory community, and the public. CSM have been built, in block diagram form, to provide information regarding the hazards, pathways, receptors, and barriers (RBES only) between the hazards and receptors. A narrative statement accompanies each CSM to describe in detail the features of the model.

Linking the hazard specific maps to the CSM with supporting narrative will depict the path to be taken to complete the RBES in respect to the hazard areas of concern for the FCP site.

1.2 SITE MISSION

The Fernald Closure Project (FCP) is located approximately 18 miles Northwest of downtown Cincinnati, Ohio. The FCP is owned and managed by the U.S. Department of Energy (DOE) and encompasses 1,050 acres. Fluor Fernald Inc., has been contracted by DOE to remediate and restore the FCP which is scheduled to be complete in 2006. Currently, the remediation of the FCP is approximately 60% complete (Table 1.1). Remediation activities are clearly visible at the site in the 140-acre former Production Area as the removal of the production facilities is near completion and remediation of the underlying soil is in process. Remediation of the 37-acre Waste Pit Area is also nearing completion and construction of the infrastructure required to support remediation of Silos (e.g., treatment facility) is in process. Borrow activities are also very visible in the southeast portion of the FCP and construction of the On-Site Disposal Facility is clearly visible in the eastern portion of the FCP.

The community of Ross is located a few miles northeast of the FCP. Immediately adjacent to the FCP site boundary are a combination of agricultural fields and residential housing. The southern and eastern boundaries of the FCP are dominated by agricultural fields with some interspersed housing. The northern and western borders of the site are bordered by private residences and agricultural fields, although some small businesses and one industrial firm are also present. Some residential property along the western boundary has been recently converted to commercial property. Within a mile of the FCP, several areas of new residential development are being constructed. Overall, the currently status of the property surrounding the FCP is not expected to significantly change within the next few years.

In December 1984, when the Fernald Site was still in uranium production mode, the release of approximately 200 pounds of uranium from a plant dust collector was reported to the National Response Center. This release notification focused nationwide attention on the environmental issues at the Fernald facility and produced increased oversight by U.S. Environmental Protection Agency (EPA) and Ohio EPA. At about the same time, local residents at the site formed a watchdog group entitled the Fernald Residents for Environment, Safety and Health (FRESH). The high public and political profile surrounding activities at the site has remained relatively unchanged since the initial groundswell of attention in 1984.

Through the subsequent CERCLA field investigations, it became clear that Fernald's historical operations had affected a significant off-property land area. Soil concentrations of approximately 20 parts per million (ppm) for total uranium (about five times background) were identified in surface soil samples collected off property, immediately adjacent to the eastern and northeastern boundary of the facility. Uranium was detected at above-background concentrations (generally less than two times background) in a widespread area off the Fernald property. It was estimated that approximately 11 square miles of surface soil was impacted at these low concentrations. The source of these low concentrations was emissions of dust particles to the atmosphere from plant stacks over the Fernald site's 37-year production history. As documented in the Fernald CERCLA Baseline Risk Assessment, soil uranium concentrations of about 1.5 ppm above background correspond to an incremental lifetime cancer risk (ILCR) of about 10^{-6} for a hypothetical residential/farming land use scenario (DOE, 1995a). In essence, the entire 11-square mile area of above-background contamination surrounding the Fernald site fell within the 10^{-6} risk boundary identified during the Baseline Risk Assessment.

To facilitate environmental restoration, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) work scope for the Fernald site was divided into five operable units (OUs) each with the corresponding Records of Decision (ROD): Waste Pits - OU1 (DOE, 1995c); Miscellaneous Waste Units - OU2 (DOE 1995d); Production Area Facilities and Legacy-Waste Inventories - OU3 (DOE, 1994a & DOE, 1996a); Silos OU4 (DOE, 1994b); and Environmental Media OU5 (DOE, 1996b). CERCLA remedial investigations and feasibility studies are complete for each of the OUs, and five final Records of Decision (RODs) have been signed to establish cleanup levels and document the chosen cleanup remedies for each OU. Since the RODs were signed , field cleanup across all of the OUs has been the primary focus . Each RI/FS evaluation also contained a Comprehensive Risk Analysis and Risk Evaluation (CRARE). The CRARE was initially developed in conjunction with OU 4 and updated in each subsequent OU.

1.3 STATUS OF CLEANUP PROGRAM

As of fall 2003, cleanup is about 60 percent complete, based on total volumes of remediation waste that has been permanently dispositioned at the respective off-site and on-site disposal locations. A summary of the major remediation projects and their current status is provided in Table 1.1.

At the time that uranium production ceased at Fernald and the RODs were signed bringing an end to the CERCLA investigative studies, it was determined that there were approximately 3.1 million cubic yards of remediation waste that required action and approximately 134 acres of on-site and off-site groundwater contamination in the Great Miami Aquifer that needed to be addressed. A key factor in the site-wide approach to the cleanup remedies, considering the significant volumes of waste involved, was the need for an on-site disposal decision in order to cost-effectively address the large quantities of soil and demolition debris materials that would be generated. However, because an on-site disposal facility would need to be located over the Great Miami Aquifer (a regulated sole-source aquifer that serves as the principal drinking water supply in the region), waivers from State of Ohio solid waste disposal siting prohibitions were necessary to accommodate this need. In order to gain the above referenced waivers, the collective remedies approved by the regulatory agencies employed a "balanced approach" in which the higher volume, lower concentration materials would be allowed to remain on site (approximately 77 percent of the total). The lower volume, more heavily concentrated materials (23 percent of the total) were disposed of off site, and all affected portions of the Great Miami Aquifer were restored to full beneficial use.

Under this site-wide balanced approach, the final remedial actions selected in the original RODs include: Production-facility decontamination and dismantlement (D&D); On-site disposal of the majority of contaminated soil and D&D debris in an engineered 2.7 million cubic yard On-Site Disposal Facility (OSDF); Off-site disposal of the contents of the two K-65 Silos (Silos 1&2) and Silo 3; Off-site disposal of all waste pit materials, caps, and liners; and Off-site disposal of the nuclear product inventory, containerized legacy waste inventories, and the limited quantities of soil and debris not meeting on-site waste acceptance criteria (WAC). The final remedial actions also included extraction and treatment of contaminated groundwater as necessary to restore the Great Miami Aquifer to full beneficial use, and achieve performance-based mass and concentration discharge limits for release of water to the Great Miami River as specified in the OU5 ROD (DOE, 1996a).

Table 1.1. FCP Cleanup Program Status.

Project	Work Scope	Status as of July 2003	2006 Strategy	Completion
Aquifer Restoration	– Remediate contaminated portions (approx. 170 acres) of the Great Miami Aquifer – Treat stormwater and wastewater resulting from site remediation activities	– Project - 66% complete – Extracted more than 14.2 billion gallons of water from the aquifer since 1993 – Treated more than 9.6 billion gallons of water – Removed more than 5,740 pounds of uranium from aquifer since 1993 – Successfully using re-injection well technology to speed aquifer remediation	– All infrastructure will be in place by 2006	2021
Building Demolition	– Dismantle 223 former production plants, support structures, and associated components	– Project - 61% complete – Dismantled 145 structures – Completed Safe Shutdown in March 1999, two years ahead of schedule and $7 million under budget – Current activities focused on D&D of Plants 2/3, 8, General Sump, Pilot Plant, and the Analytical Laboratory	– Add work crews, safety personnel, and equipment – Expedite demolition of structures	2006
Soil and Disposal Facility	– Remediate and dispose of contaminated soil – Certify site as clean and perform natural resource restoration	– Project - 41% complete – Cell 1 – filled and capped – Cell 2 – filled and capped – Cell 3 – 98% filled – Cell 4 – 55% filled – Cell 5 – 10% filled – Cell 6 – 9% filled – Excavated and dispositioned over 1.35 million cubic yards of contaminated soil – Over 57% of the site is certified "clean" – Completed four natural resource restoration projects	– Adopt self-performance and aggressive approach to work – Resequence work with more parallel activities – Greater integration with D&D and Waste Pit projects – Add Cell 8 to accommodate scope increase	2006

Project	Work Scope	Status as of July 2003	2006 Strategy	Completion
Silos 1 and 2	– Remove 8,900 cubic yards of high activity low-level waste from two concrete silos – Chemically stabilize waste and ship off site for disposal	– Project - 30% complete – Accelerated Waste Retrieval Subproject – 95% complete	– Use commercial design-build approach to integrate project activities and accelerate schedule – Implement a detailed constructability process to maintain required coordination of efforts – Revise design to increase operating flexibility and reduce downtime – Develop options for transportation and disposal	2006
Silo 3	– Remove 5,100 cubic yards of low-level waste from one concrete silo – Ship waste off site for disposal	– Project - 70% complete – Construction is 100% complete	– Prepared ROD Amendment and Revised Proposed Plan to allow for treatment only as required to meet permitted disposal facility's waste acceptance criteria – Planning for opportunistic funding that would allow early completion	2006
Waste Pits	– Remediate the contents of six waste pits containing low-level radioactive waste byproducts of uranium and thorium processing	– Project - 80% complete – 107 unit trains pulling 6,351cars have shipped 683,287 tons of waste	– Operate dryers 24/7 to address increased waste tonnage – Lease additional railcars – Evaluate plans to reduce number of shipments to Envirocare	2004

Project	Work Scope	Status as of July 2003	2006 Strategy	Completion
Waste Management	– Characterize, sample, package, and dispose of low-level radioactive, hazardous, and mixed waste site inventories – Provide site-wide support for waste planning and off-site shipping – Emphasize waste minimization, recycling or reuse wherever practical	– Project - 99% complete – Shipped 6.4 million cubic feet low-level waste to the Nevada Test Site for disposal – 99% complete – Shipped 163,912 low-level liquid mixed waste off site for incineration – 93% complete – Transferred 588,207 cubic feet low-level waste to Waste Pits Remedial Action Project – 94% complete – Transferred 792,510 cubic feet low-level waste to OSDF – 100% complete – Shipped 23,778 cubic feet low-level mixed waste off site for treatment – 89% complete – Dispositioned all containerized waste on Plant 1 Pad – Approximately 1,870 containers remaining in inventory – Continue characterization, visual inspection, and packaging of uranium waste	– Maximize on site disposition of low-level waste – Pursue off-site treatment of mixed waste and low-level waste	2003
Nuclear Material Disposition	– Characterize, package, and ship nuclear materials off site	– Project – 100% complete – Dispositioned 31 million pounds of nuclear product through: ▪ Transfer to other DOE site for programmatic use ▪ Sale to private sector ▪ Transfer to Portsmouth Facility for interim storage under DOE's Uranium Facility Management Group (9.1 million net pounds transferred since June 1999) ▪ Burial of Department of Defense materials off site		2002

As of January 2004 , the following cleanup benchmarks have been achieved:

- 683,287 tons of Waste Pits material have been shipped off site and 107 unit trains have made the round trip from Fernald to the Envirocare disposal facility in Utah;
- More than 1.35 million cubic yards of contaminated soil and debris has been excavated and placed in the OSDF;
- 6 of 8 individual disposal cells are in place;
- 9 of 10 uranium production plants have been dismantled;
- 145 individual structures have been dismantled;
- nuclear materials disposition is complete;
- 6.4 million cubic feet of low-level waste has been shipped by truck to the Nevada Test Site for disposal;
- 57 percent of the 1050-acre site footprint has been certified as meeting radiological and chemical cleanup levels; and
- 14.2 billion gallons of contaminated groundwater has been pumped and treated, as necessary, to achieve surface water discharge limits.

As the above metrics serve to illustrate, the Fernald cleanup is mature and the site is on target for a baseline closure in June 2006. Upon closure in June 2006, all that will remain will be the ongoing actions necessary to achieve final cleanup of the Great Miami Aquifer restoration and the long-term stewardship activities necessary to accommodate and maintain the designated final land use. At closure, approximately 975 acres of the site property will be restored to permit beneficial use as an Undeveloped Park (the selected final land use objective), and approximately 75 acres will be dedicated to the footprint of the OSDF. Other than the disposal facility, no sources of contamination above the site's final remediation levels (FRLs) will remain on site when cleanup is complete.

1.3.1 Regulatory and Stakeholder Inputs Received to Date

This document has been prepared pursuant to the DOE Guidance for Developing a Site-Specific Risk-Based End State Vision (DOE, 2003a). The future mission for Fernald will be Legacy Management of the areas of concern left on site. The decisions concerning the final list of hazards to be left on site, will be evaluated collaboratively with the participation of the FCAB, EPA, and Ohio EPA.

During October 2003, initial meetings were held with the FCAB and the Regulatory Agencies to identify issues of concern with the changes that may be contemplated under the RBES Vision. It was clear from the initial interactions that the FCAB and the Regulators have significant concerns with the changes outlined in this RBES Vision/Variance. The FCAB and agencies also raised concerns that the RBES process could create distractions and resource demands that ultimately detract from achieving the 2006 closure schedule if not managed wisely, considering the progress of remediation already being made in the field.

To illustrate the type of issues and concerns that are currently on the minds of the local and political community regarding emerging changes for the FCP, comments and correspondence are included in Attachment B to this document:

- An October 9, 2003 congressional letter, signed by Ohio senators and congressmen, raising concerns with the Comprehensive Groundwater Strategy Report (DOE, 2003b) and potential changes to existing cleanup agreements;
- A series of articles concerning the RBES Process, Groundwater Strategy Report and DOE's decision-making process for arriving at changes to cleanup agreements.
- A summary of the public comments received at the November 18, 2003 public meetings;
- A series of letters providing comments on the Fernald RBES process from the Agencies and Stakeholders.
- Selected DOE responses to comments and letters received on the RBES Vision and process.

The information contained in the above listed items illustrate the overall public and regulatory attitude toward any changes to the current remedies contained in the site's five RODs.

In a letter to the stakeholders dated January 9, 2004, DOE requested major specific comments by January 20, 2004 and detailed technical comments by March 15, 2004. It is DOE's intent to address comments in the final revision that is due to Headquarters on March 30, 2004.

1.3.2 Fernald's Decision-Making Context (Based on Previous Risk-Based Remedy Decisions)

To assist the DOE and the community with the decisions being contemplated under the CERCLA cleanup process, the Fernald Citizens Task Force (now known as the Fernald Citizen's Advisory Board, or FCAB) was formed in the early 1990s to make recommendations regarding land use objectives, residual risk levels, and to help develop an approach to navigating the technical and political considerations surrounding the need for an on-site disposal alternative. At the time the remedial decisions were being contemplated, there was little dispute over the need to remove, treat, and/or dispose of the source materials from the source OUs themselves. Likewise, there was little dispute over the need to restore the Great Miami Aquifer to full beneficial use. The cleanup of the contaminated soil posed a difficult management problem because of the following: The large volumes and acreages of contaminated material with associated high costs of cleanup; The risk presented by contaminated soil is real but the harm is seldom imminent; The technology for treating soil is often imperfect; and The materials that are removed during cleanup must be disposed somewhere and no place is eager to host them. The complexity of this management problem was noted by the FCAB in their deliberations

The strategy for finalizing sensible soil cleanup levels (and the resultant extent of soil excavation) involved a process of consensus building with local residents, EPA, Ohio EPA and DOE, and in marrying the CERCLA decision process with the deliberations of the FCAB regarding land-use based final cleanup levels. At the time of the FCAB deliberations, the 11-square mile area represented an excavation volume of nearly 10 million cubic yards, if a 10^{-6} risk target (5 ppm total uranium) were to be selected as the land-use based final soil cleanup level. Present-worth cost estimates for such an excavation effort, when coupled with the Great Miami Aquifer restoration remedy, approached more than $4.3 billion dollars. The FCAB's deliberations and educational efforts with the community helped them understand the short- and long-term risk evaluations and tradeoffs involved, effective consensus building led to the selection of a 50 ppm total uranium off-site soil cleanup level (corresponding to a 3.5×10^{-5} ILCR and Hazard Index (HI) of 1.0 for non-carcinogenic health effects) as the appropriate risk-based value. When coupled with the on-site disposal decision for contaminated soil and debris, this decision reduced present worth costs from an estimated $4.3 billion as mentioned above, to a more realistic $580 million. Equally as important, the decision reduced the area of excavation to approximately 400 acres, down from the potential 11-square miles previously under consideration. It is important to note that the above listed decisions were endorsed by the FCAB, in conjunction with EPA and Ohio EPA

Also, during the solicitation of community input for the remedy decisions, it became clear that virtually no Stakeholders or members of the public were interested in seeing the on-site area of Fernald returned to an unrestricted residential/farming land use following remediation. From this basis, and on the recommendations of the FCAB, EPA, Ohio EPA, and DOE collectively agreed to adopt what was known as Land Use Objective No. 3 (a restricted, non-farming land-use objective) for the setting of sensible on-site soil cleanup levels. Individual constituent cleanup levels for a designated hypothetical Undeveloped Park receptor were then set at an ILCR of 10^{-6} and a HI of 0.2. These target values, recognizing other non-farming land uses (e.g., commercial, industrial, and developed park) could be possible for the site in the future while meeting the corresponding land use-specific risk range targets (1×10^{-4} to 1×10^{-6} ILCR and HI=1) considered acceptable by EPA in the National Contingency Plan. These deliberations and the consensus building resulted in the selection of Alternative 3A from the Fernald OU5 Proposed Plan (excavation of contaminated soil and placement in an engineered on-property disposal facility to achieve on-site Undeveloped Park risk-based levels) as the preferred remedy for the site. The final cleanup decision provided a health-protective remedy that is reliable over the long term, yielded the lowest overall short-term risks, and is less costly when compared to the other alternatives (DOE, 1995b). This consensus risk-based decision was then documented in the January 1996 OU5 ROD (DOE, 1996b).

1.3.3 Opportunities and Challenges Facing Future RBES Decisions

As the above background discussion illustrates, the FCAB, in conjunction with local Stakeholders and the Regulatory Agencies, plays a vital role in making the key collaborative Fernald decisions that are risk based and/or final land-use focused. The FCAB also plays a pivotal role in gaining public consensus and educating local public members in the short- and long-term tradeoffs involved in CERCLA remedial decision-making. During recent meetings on Fernald's RBES opportunities, both the FCAB and the Regulatory Agencies strongly pointed out that the risk-based decisions already reached for the Fernald site to arrive at the original cleanup remedies, sensible soil cleanup levels, and land-use preferences have already produced a solid "RBES Vision" for Fernald that, in their mind, requires little further tailoring.

In recognition of this backdrop, it was agreed in concept during the initial dialogue between DOE and its Stakeholders and Regulators that the FCAB would serve as the primary deliberative body for gaining public consensus on acceptable new risk-based initiatives emerging from the RBES Vision. EPA and Ohio EPA (who also sit on the FCAB) would serve as the primary deliberative organizations for determining the regulatory acceptability of the new initiatives, should they require revisions to existing cleanup agreements and/or implementation requirements. Through the collaborative interactions with these primary bodies, the aggressive master list of technically supportable initiatives will be screened for further applicability to arrive at the final shortlist of viable initiatives that can be implemented beneficially given the present status and remaining timetable for the cleanup remedies underway.

Significant ongoing dialogue with the FCAB and the regulatory agencies concerning the RBES deliverables occurred in early October 2003. The RBES policy was an agenda topic at the FCAB's annual retreat, and was the subject of a quarterly FCAB meeting on October 21, 2003. Individual meetings with local stakeholder groups, such as FRESH, have been held , along with the featuring of the initiatives during monthly Fernald Cleanup Progress Briefings held for the local public. At the October 21, 2003 FCAB meeting, a consensus was reached between DOE and the FCAB regarding the ongoing interactions that will be necessary to move into the shortlisting process for the initiatives. A public meeting on the RBES process was held on November 18, 2003. A general letter to Stakeholders was also issued announcing the November 18, 2003 public meeting and asking for input and participation in the RBES process. Feedback received from the Regulatory Agencies, indicates that they are unwilling to support any of the RBES initiatives contained in this report. Additional discussions are planned in the coming months, particularly pertaining the groundwater scenario as described below. It has been agreed that Fernald would continue to follow the same level of deliberative processes employed during the original

CERCLA decision-making (and subsequent ROD changes already in place) in the future consideration of changes to the current plan.

In light of Fernald's decision-making landscape and the RBES interactions already underway, a summary of the master list of technically supportable opportunities that are contained in the RBES Vision, are provided in the bullets below. These opportunities were all identified in the September 2003 timeframe, for inclusion in the Vision.

- Allow use of an area averaging and hot-spot approach for OSDF soil WAC demonstration (just like soil cleanup standards). Currently, a "not to exceed" approach is required by the OU5 ROD (DOE, 1996a).

- Use the Fernald sediment cleanup levels in all streams and ponds on site. Currently, these levels are limited to the Great Miami River and Paddys Run.

- Use the cross-media aquifer protection soil cleanup levels for subsurface soils (below 3 feet) rather than the surface soil cleanup levels.

- Allow Fernald's outfall lines to be cement-stabilized, or cleaned, and left in place.

- Discharge OSDF leachate that meets surface water cleanup levels to on-site ponds, rather than requiring the leachate to be automatically treated before discharge.

- The AWWT facility will be shut down, undergo D&D, and be disposed of in the OSDF, along with the underlying, impacted soil, by the Site Closure date of June 30, 2006. The most cost-effective infrastructure to support groundwater remediation post 2006 closure will be identified and installed to replace the AWWT.

All of the above listed opportunities would change Fernald's end-state residual contaminant levels under current cleanup agreements. All of the opportunities can be technically supported under a risk-based decision-making concept. These opportunities are presented in detail in the RBES Vision so that the variances between the opportunities and current cleanup agreements, along with the cost/benefits, can be identified and evaluated by Fernald's decision-making participants.

Outside of the RBES process, ongoing improvements to the remediation processes, which do not change the residual risk level or end-state condition of the site, are constantly being identified, developed, and pursued under the normal CERCLA process with Fernald's Stakeholders and Regulators. This process has been in place since the RODs were signed and has been successful in shortening the cleanup schedule and reducing costs, while maintaining the short- and long-term level of protectiveness to the environment consistent with the agreements in place. This mature and time-tested process remains in place and will continue to be utilized to review new improvements that are identified throughout the remainder of the cleanup effort.

1.3.4 Lessons Learned Regarding RBES Decision Making – Groundwater-Based Opportunities

One of the requirements of the 2003 Fernald Closure Contract Modification Number M038 is the need to identify the most cost-effective groundwater infrastructure to remain at the site when the other baseline work elements defining Site Closure are complete at the end of June 2006. Since the full restoration of the Great Miami Aquifer will occur to the same end state sometime after 2006 regardless of the treatment/infrastructure decisions being contemplated under Modification M038, the decisions are

technically not a RBES Vision opportunity. Fernald is engaged with the FCAB and the Regulatory Agencies regarding the options for the D&D of groundwater treatment infrastructure in time for the resultant surface and subsurface soil and debris to be placed into the OSDF before that facility permanently closes.

In early October 2003, an internal working draft of DOE's Comprehensive Groundwater Strategy Report was shared with the FCAB, local Stakeholders, and the Regulatory Agencies, outlining a number of major groundwater treatment alternatives for consideration including the regulatory relief that may be necessary from existing cleanup agreements for each alternative in order to achieve the objectives contemplated (DOE, 2003b). Follow-up discussions with Stakeholders were held as part of the December 2, 2003 FCAB meeting. An additional public meeting was held on January 13, 2004 to provide a "toolbox" to Stakeholders to clarify the alternatives outlined in the Groundwater Strategy Report. Excerpts from the "toolbox" are provided in Appendix C.

It was agreed that Fernald would continue to follow the same level of deliberative processes employed to date in the future consideration of any changes in the current plan for groundwater and wastewater treatment, and the possibility of the early D&D of existing water treatment facilities. This agreement was similar to the consensus reached at the October 21, 2003 FCAB meeting regarding RBES Vision opportunities. In that light, a meeting is scheduled for February 18, 2004 to continue the discussion with Stakeholders on this issue. DOE remains committed to working collaboratively with the FCAB and the Regulatory Agencies to identify a preferred course of action in the future.

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2.0 REGIONAL CONTEXT RISK-BASED END STATE DESCRIPTION

2.1 PHYSICAL AND SURFACE INTERFACE

The FCP site is located in southwestern Ohio in Hamilton and Butler counties. The topography in southwestern Ohio includes gently rolling uplands with steep hillsides along the major streams such as the Great Miami River and Paddys Run. Agricultural fields, with interspersed woodlots and riparian corridors, dominate the tillable areas around the FCP. Development has increased in the area around the FCP in the last decade converting agricultural fields to residential use. Although the trend of increased residential development is expected to continue, the counties of Hamilton and Butler do not anticipate any major changes in the regional topography (See Figure 2.1b).

The land in Hamilton and Butler counties within the region of the FCP site is privately owned for agricultural, residential, and commercial use. According to the Butler and Hamilton Counties projected future land use, the land will remain privately owned for agricultural, residential, and commercial use. The FCP site will remain under federal ownership. The OSDF and buffer zone will remain DOE property in perpetuity to allow DOE to continuously monitor and maintain the facility. In the event that DOE transfers management of the OSDF to another federal government entity, the appropriate restrictions and limitations will be communicated and implemented (e.g., deed restrictions).

2.2 HUMAN AND ECOLOGICAL LAND USE

The FCP site is located near the communities of Shandon (northwest), Ross (northeast), New Baltimore (southeast), Fernald (south), and New Haven (southwest) and lies on the boundary between Hamilton and Butler counties (See Figure 2.2b).

The land cover of Hamilton and Butler Counties is mainly agricultural-. Land around the communities of Shandon, Ross, and New Baltimore is residential. There are two areas of commercial/industrial land cover: one southwest of Shandon and one along the upper west boundary of the FCP site. Although the land of the FCP site used to be agricultural, activities conducted to support the production mission have significantly altered the topography; therefore the land cover is barren. The barren land east of the site is a gravel excavation operation.

Based on the 1990 census, the 5-mile radius around the FCP site contains an estimated 22,900 people while the eight-county Cincinnati consolidated metropolitan statistical area has a population of more than 1.7 million and a labor force of more than 920,000. Scattered residences and several villages are located near the FCP property. Residential units are concentrated in Ross to the northeast, in a trailer park to the east, and in New Baltimore to the southeast.

Within 5 miles there are six schools that enroll 3316 students, two day care centers that enroll about 160 children, and residences that house about 8140 children. The Ross Local Schools District is constructing a new secondary school to support the increase in attendance due to recent development in the school district.

The area around the FCP remains predominantly open and agricultural and the site itself was farmed before construction of production facilities in 1951. Residences, many of them farmsteads, are scattered around the area and a dairy farm is located just outside the southeast corner of the FCP boundary. Due to a long history of intensive agriculture, there is very little nearby land where a natural environment remains intact. Miami-Whitewater Forest operated by Hamilton County Park District contains more than 2,000 acres of woodlots and former agricultural areas that have been converted to prairie and wetlands and is located approximately 3 miles West of the FCP.

Commercial activity is generally restricted to the village of Ross, approximately 3 miles to the northeast. Industrial use is concentrated along State Route 128, in a small industrial park south of the FCP property, in the village of Fernald, and along the site's western boundary.

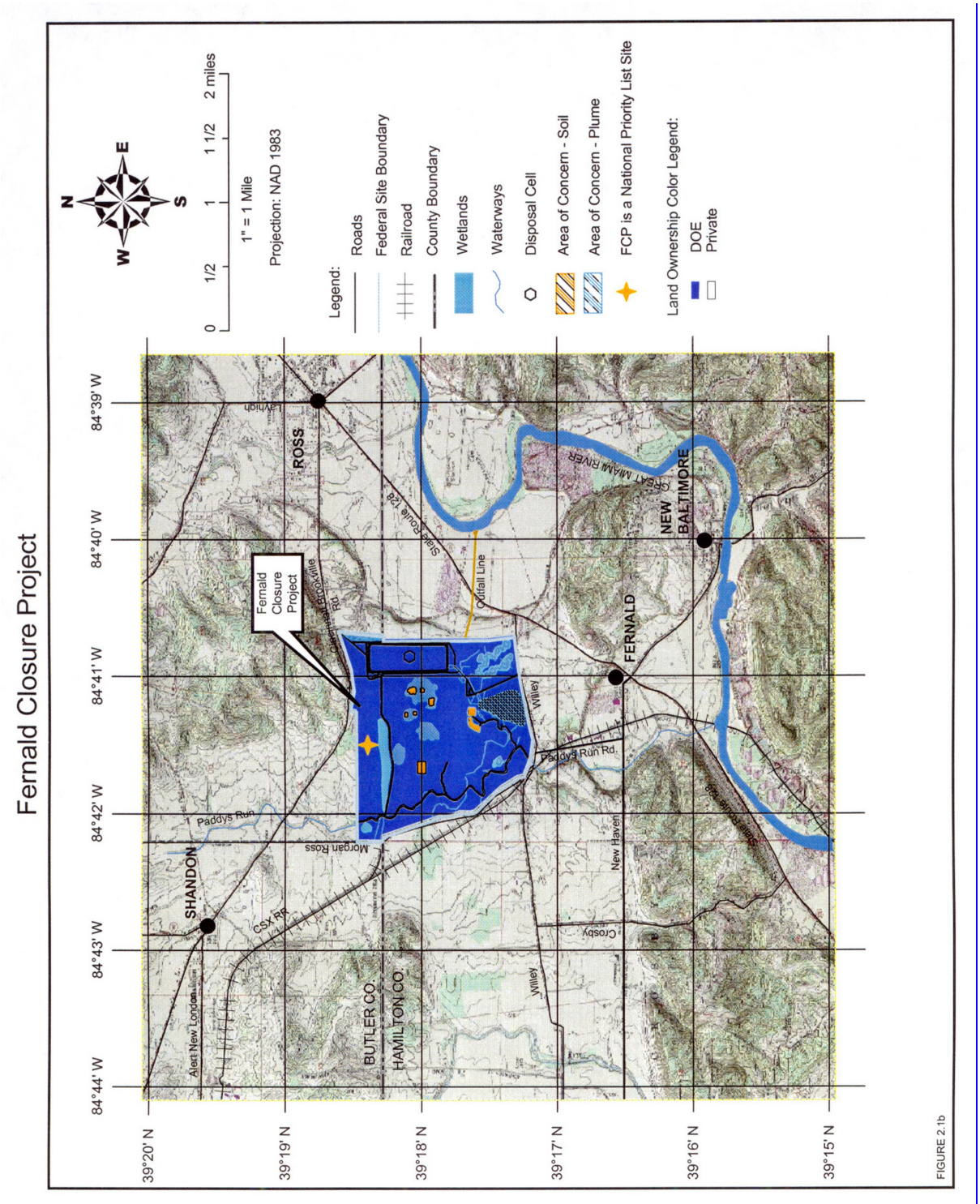


Figure 2.1b. Regional physical and surface interface – RBES.

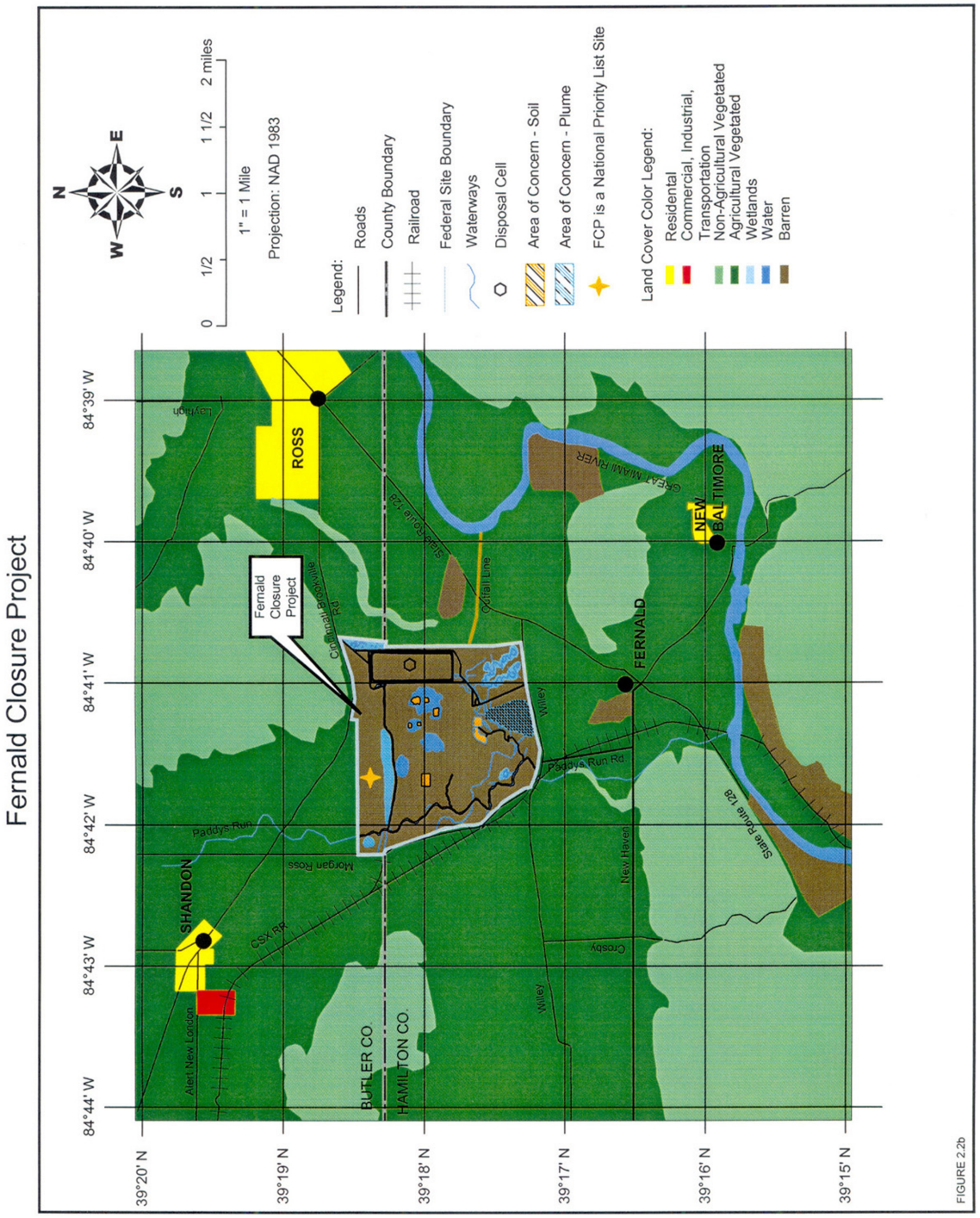


Figure 2.2b. Regional human and ecological land use – RBES.

The Great Miami Aquifer is designated as the sole drinking water source (under Section 1424(e) of the Safe Drinking Water Act) for over 600,000 people in Southwestern Ohio, providing 100 percent and 48 percent of the potable water for Hamilton and Butler counties, respectively. Some residents within a 5-mile radius of Fernald rely on private wells, cisterns or bottled water for potable water. FCP area farms use wells to irrigate their fields and farmers along the Great Miami River irrigate with river water.

The majority of the FCP lies within Hamilton County, Ohio. Hamilton County was consulted during development of the Final Land Use Environmental Assessment (EA) for the FCP (DOE, 1999b). The Hamilton County Planning Commission has a conceptual development plan for the area surrounding the FCP that projects primarily commercial/industrial development immediately adjacent to the western portion of the FCP. The properties immediately to the East and South of the FCP are identified for continued residential and agricultural use. The Northern portion of the FCP lies in Butler County, Ohio and consultation occurred with Butler County Planning Commission. The property immediately adjacent to the Northern boundary of the FCP is primarily residential and agricultural and is expected to remain in those land uses.

3.0 SITE SPECIFIC RISK-BASED END STATE DESCRIPTION

3.1 PHYSICAL AND SURFACE INTERFACE

The FCP site is a 1050-acre facility located in southwestern Ohio, about 18 miles northwest of downtown Cincinnati. The facility is located just north of the small rural community of Fernald and lies on the boundary between Hamilton and Butler counties (See Figure 3.1b).

The FCP currently has approximately 400 of the 1050 acres disturbed due to ongoing remediation work. The Former Production Area, Waste Pit Area, Silos Area, OSDF, and Borrow Area are all in a condition of surface disturbance due to soil excavation, disposal or other construction activities. Infrastructure for the Aquifer Restoration Project (e.g., wells, pump houses) is visible in much of the southern perimeter area of the FCP and off-site areas south of the FCP. The majority of the perimeter areas of the FCP are either former pastures, woodlots or stream corridors that have been restored to the early stages of prairie or woodlot or are in the process of being restored to natural areas.

The RBES of the FCP site will be an Undeveloped Park with limited public access for educational purposes. The FCP site will remain under federal ownership. The OSDF and buffer zone will remain DOE property in perpetuity to allow DOE to continuously monitor and maintain the facility. In the event that DOE transfers management of the OSDF to another federal government entity, the appropriate restrictions and limitations will be communicated and implemented (e.g., deed restrictions).

The land immediately adjacent to the FCP site is privately owned for agricultural, residential, and commercial use. According to the Butler and Hamilton Counties projected future land use, the land will remain privately owned for agricultural, residential, and commercial use. All of the land that borders the southern perimeter of the FCP and almost half of the land that borders the eastern perimeter of the FCP is owned and farmed by one family. Indications are that this property will remain as agricultural land with the currently family continuing to live on and farm the property. The remainder of the property that borders the eastern perimeter of the FCP is privately owned, agricultural land and will likely remain as such. The majority of the land that borders that northern perimeter of the FCP is owned by a single land-owner who lives and farms the property. There is no indication at this time that this property will be sold or developed. The western perimeter of the FCP is bordered by a series of private residences, businesses or agricultural land. One private residence is being sold as commercial property at this time. There is the potential that additional private residences or agricultural land will be developed over the next decade.

Access to the site will be available by the North and South Access Roads. The North Access Road will be accessible by State Route 126 that runs along the northeast corner of the FCP site. The South Access Road will be accessible by Willey Road that runs along the southern property boundary and intersects State Route 128 to the east of the site. The access road around the OSDF will be left to provide access for inspection and maintenance during Legacy Management.

Activities conducted to support the original site mission have significantly altered the topography of the FCP site. The end state of the site will be mainly forest (395 acres) and prairie (327 acres). The OSDF and buffer zone will cover approximately 75 acres, wetlands will cover approximately 81 acres, and lakes will cover approximately 60.4 acres.

Paddys Run flows from north to south along the FCP's western boundary and empties into the Great Miami River approximately 1.5 miles south of the site. Paddys Run is an ungauged, intermittent stream that flows primarily between January and May with an estimated discharge of 0.2 to 4 cubic feet per second (cfs).

3.2 HUMAN AND ECOLOGICAL LAND USE

Risk to ecological receptors is being considered as part of the remediation of the FCP. Ecological risks were first addressed through the Sitewide Ecological Risk Assessment (SERA), which was conducted as part of the Operable Unit (OU) 5 Remedial Investigation (DOE, 1995a). The SERA assessed both radiological and non-radiological risks. Dose estimates to receptor organisms demonstrated that there was no ecological risk due to effects from radiation at the Fernald site. For non-radiological risks, contaminant concentrations were compared to media-specific benchmark toxicity values (BTVs). BTVs are not cleanup levels, but rather literature-derived concentrations that are considered protective of ecological receptors. Based on this review, several contaminants warranted further investigation. Further studies were deferred until human health-driven remedial activities were better defined.

Non-radiological ecological risks were subsequently re-evaluated as part of the Sitewide Excavation Plan (SEP). Updated site soil data, background concentrations, human health Final Remediation Levels (FRLs), and remediation footprints were again compared to BTVs. These exercises revealed that remedial activities should address most potential risks to ecological receptors. However, several constituents that exceed BTVs may remain following soil excavation. In these instances, constituents of ecological concern (COECs) have been included as part of the soil certification process. Certification data are compared to corresponding BTVs in order to determine if additional investigation is necessary. To date, remedial activities have addressed all ecological concerns, as no certification data have exceeded soil BTVs.

Several surface water and sediment BTV exceedances were documented on and off property in the SERA. Like soil, these potential risks were re-evaluated as part of the SEP. Surface water Surface water would include both on-property locations such as Paddys Run and the Great Miami River off-property. Surface water and sediment BTVs were compared against background concentrations and human health FRLs. Again, like soil, this process revealed that human health-driven remedial activities would address the majority of potential risks to ecological receptors. Remaining COECs were included in the Integrated Environmental Monitoring Plan (IEMP) surface water and sediment sampling program. Since its inception, IEMP surface water sampling has resulted in only a few sporadic BTV exceedances. DOE has since gained approval to eliminate most BTV-driven surface water sampling, although data collected for other purposes will continue to be reviewed to ensure protectiveness of ecological receptors. Sediment COECs will be handled similar to the approach for soil COECs, as they will be included in the certification sampling program following stream corridor remediation efforts.

The SEP evaluation also investigated the potential for post-remediation soil concentrations to contaminate surface water and sediment. Soil COECs were evaluated using the site Surface Water Flow and Infiltration Model. Maximum anticipated post-excavation soil concentrations were established for each drainage sub-basin recognized by the model. When a soil concentration was not available, background concentrations were used. The results of this effort revealed that no cross media impacts would be a concern.

During the solicitation of community input for the remedy decisions, it became clear that virtually no Stakeholders or members of the public were interested in seeing the on-site area of Fernald returned to an unrestricted residential/farming land use following remediation. Therefore, the final RBES land use of the FCP site will be an Undeveloped Park with limited public access for educational purposes with the goal to educate the public about regional environmental, cultural, historical, and ecological issues (See Figure 3.2b).

Approximately 900 acres of the site's ecological natural resources will be restored. The restored habitat types will include upland forest, riparian forest, tall grass prairie, wetlands, and open water. Wetlands cover approximately 81 acres of the site. Deep excavations in the former production area will be converted to ponds. Restoration of the site will begin with grading for stability, erosion control, and to establish proper drainage patterns. The revegetation of the site will occur through the installation of native species of saplings, shrubs, or seedlings in designated areas. Other areas of the site will be seeded using native prairie grasses. The Paddys Run corridor represents excellent habitat for the federally endangered Indiana bat and the state threatened Sloan's crayfish inhabits portions of the creek. The riparian corridor along Paddys Run will be enhanced through the Restoration efforts described below.

The FCP site is situated over the Great Miami Aquifer, which is a sole-source aquifer that generally flows from west to east, with a component of the flow directed towards the south. Approximately 179 acres of on-site and off-site portions of the Great Miami Aquifer have been contaminated by FCP site mission activities. The contaminated groundwater will be extracted, treated/processed, blended with untreated storm water and remediation wastewater, and discharged to the Great Miami River as necessary to restore the Great Miami Aquifer to full beneficial use.

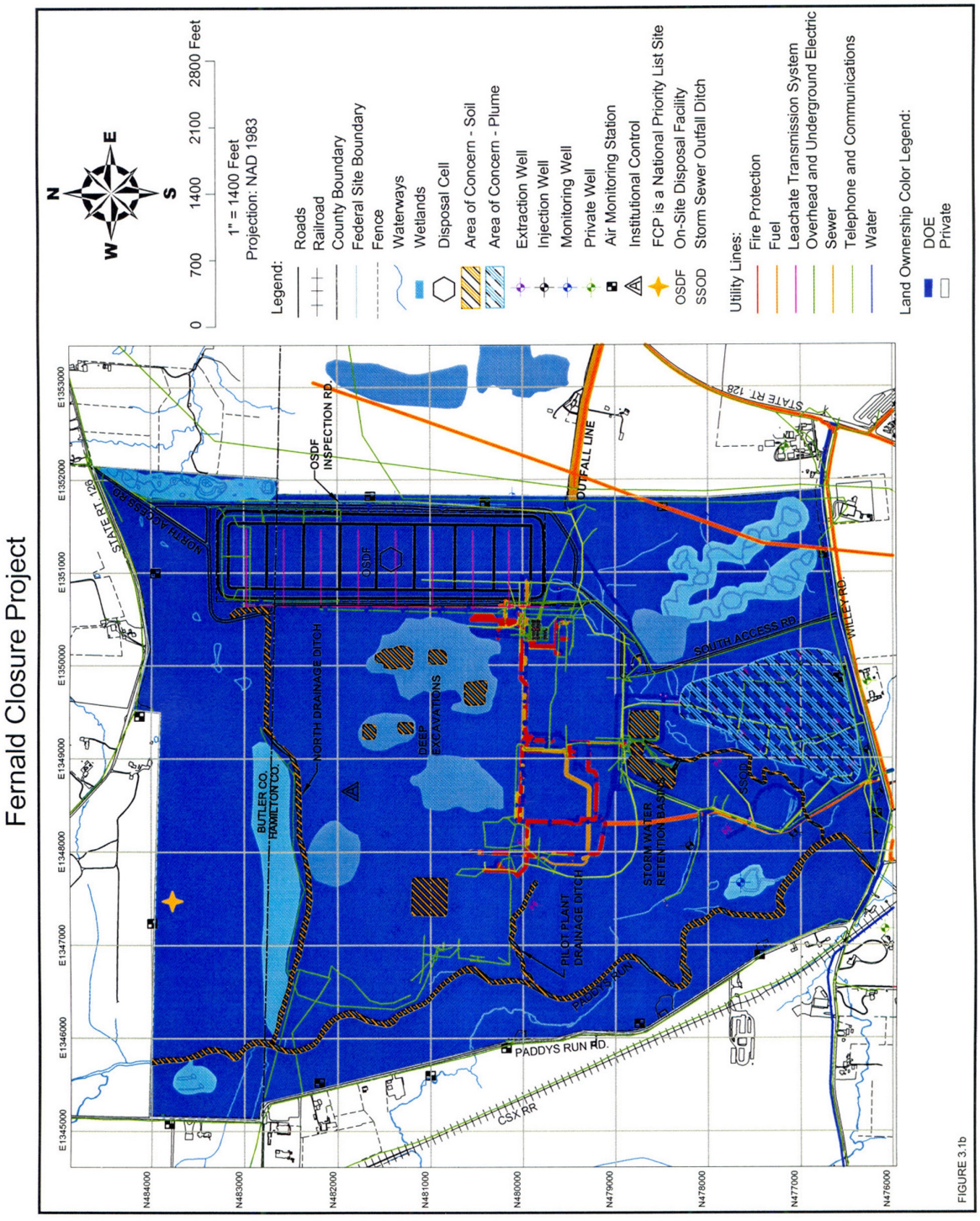


Figure 3.1b. Site physical and surface interface – RBES.

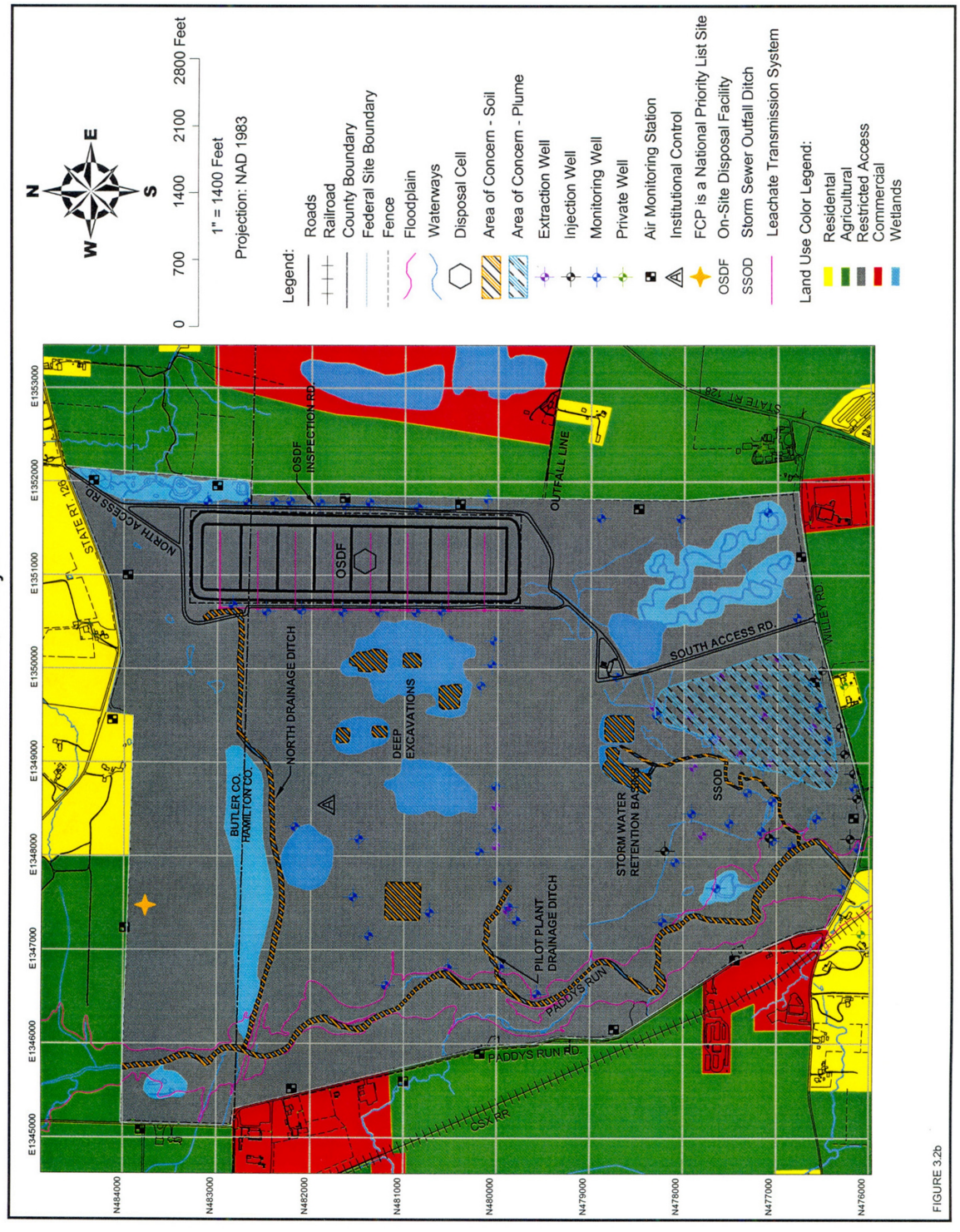


Figure 3.2b. Site human and ecological land use – RBES.

3.3 SITE CONTEXT LEGAL OWNERSHIP

The FCP site will remain under federal ownership with limited public access for educational purposes. The OSDF and buffer zone will remain DOE property in perpetuity to allow DOE to continuously monitor and maintain the facility. In the event that DOE transfers management of the OSDF to another federal government entity, the appropriate restrictions and limitations will be communicated and implemented (e.g., deed restrictions).

The land immediately adjacent to the FCP site is privately owned for agricultural, residential, and commercial use. According to the Butler and Hamilton Counties projected future land use, the land will remain privately owned for agricultural, residential, and commercial use (See Figure 3.3b).

3.4 SITE CONTEXT DEMOGRAPHICS

The final land use of the FCP site will be an Undeveloped Park with limited public access; therefore, there will be no residential use of the site.

The land immediately adjacent to the site is sparsely populated and primarily used for agricultural and commercial purposes. The population density around the FCP site is projected to be less than 10 people per square mile (See Figure 3.4b).

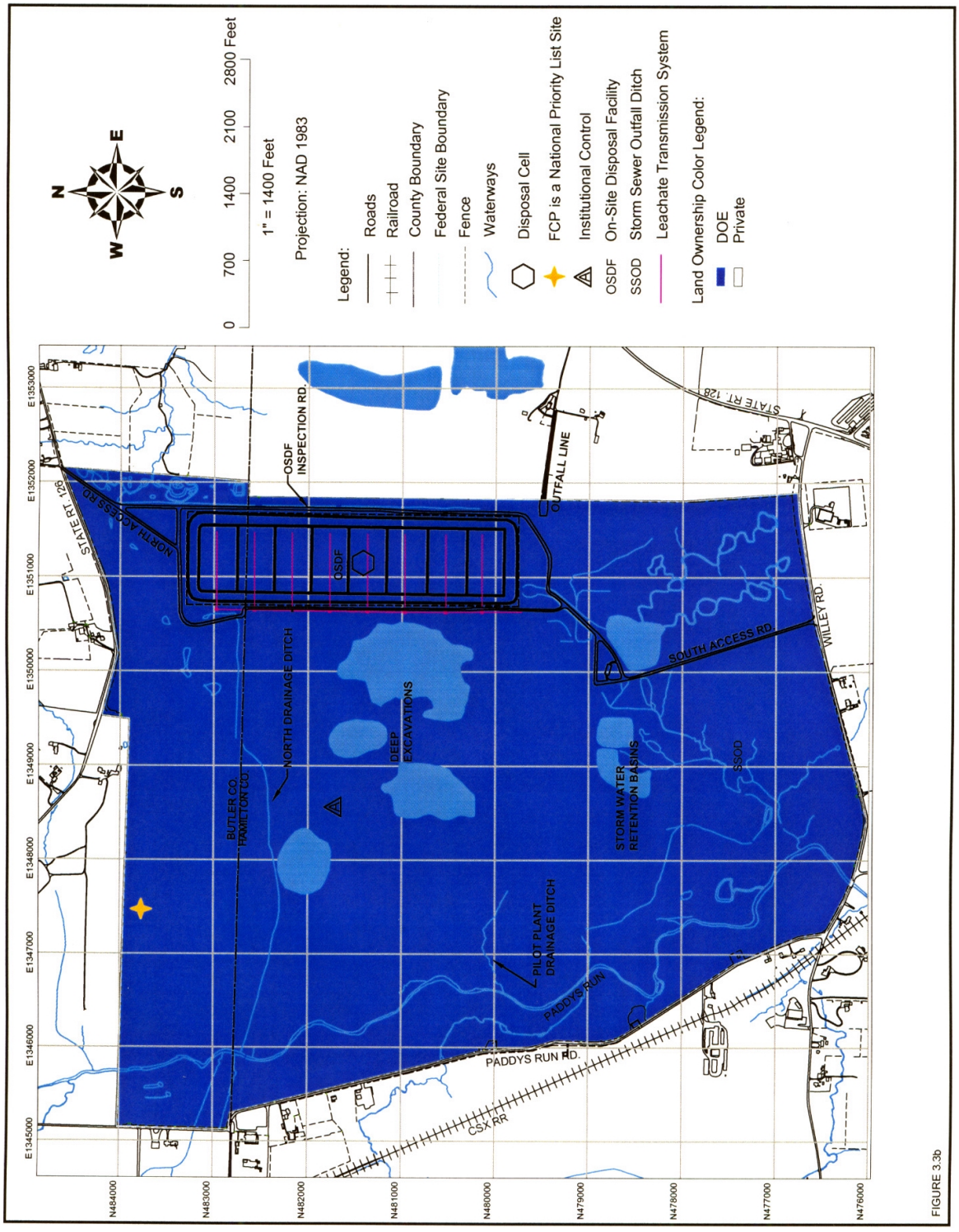


Figure 3.3b. Site legal ownership – RBES.

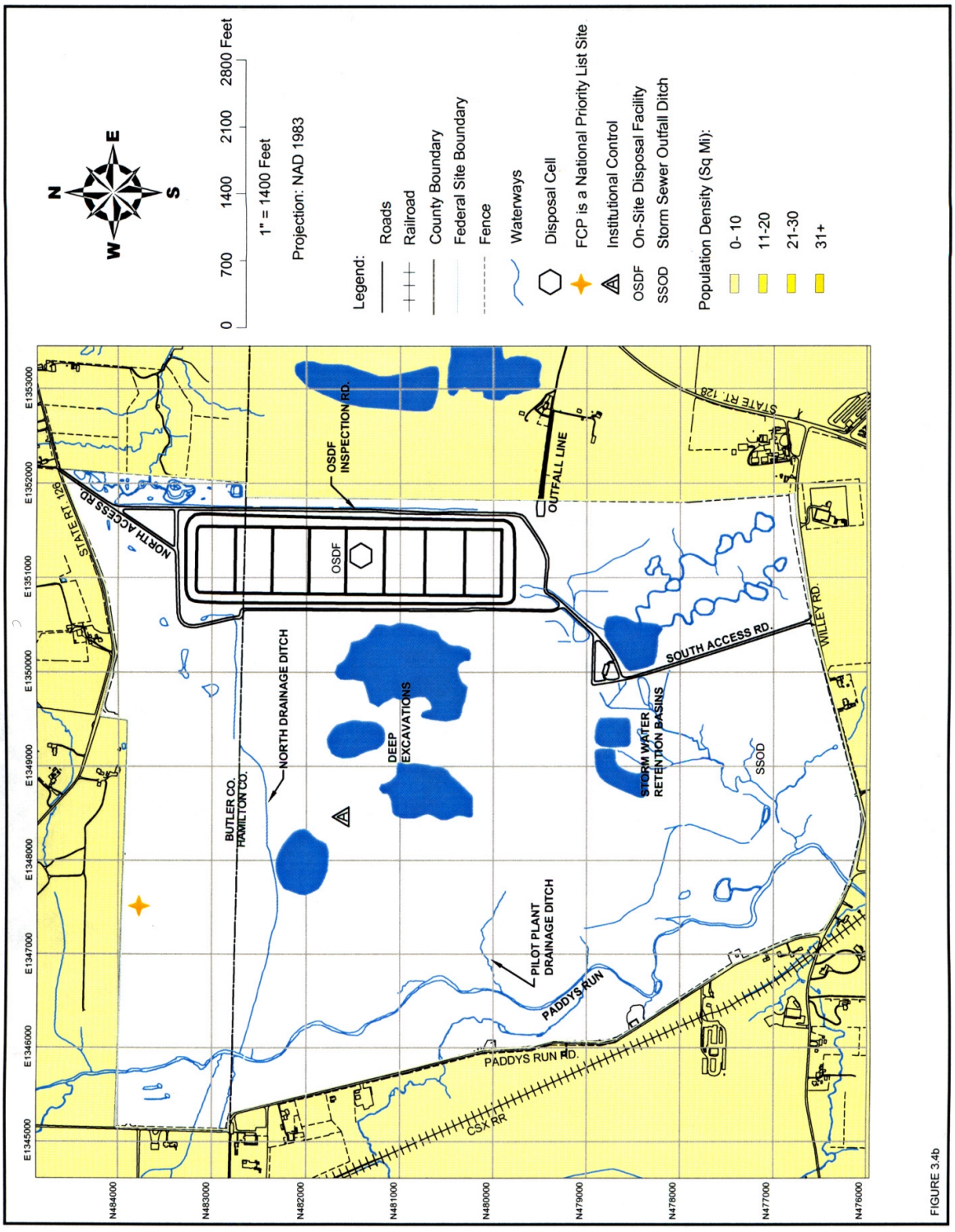


Figure 3.4b. Site context demographics map – RBES.

4.0 HAZARD SPECIFIC DISCUSSION

Four hazard areas of concern have been identified for the FCP site (See Figure 4.0b). These hazards are components of the RBES Vision that vary from the current agreements. The selected remedial strategies for the hazards are designed to be protective of human health and the environment.

The following sections describe the hazard areas and the selected remedial strategies in detail. In addition, maps, CSM, and narratives have been developed to depict each of the hazard areas. **(Please Note: The CSM development process outlined in the RBES Guidance indicates that for a given hazard all possible exposure mechanisms and receptors be depicted on the CSM even if the barrier or intervention that has/will be implemented will limit or eliminate the exposure mechanism or risk to the receptor.)**

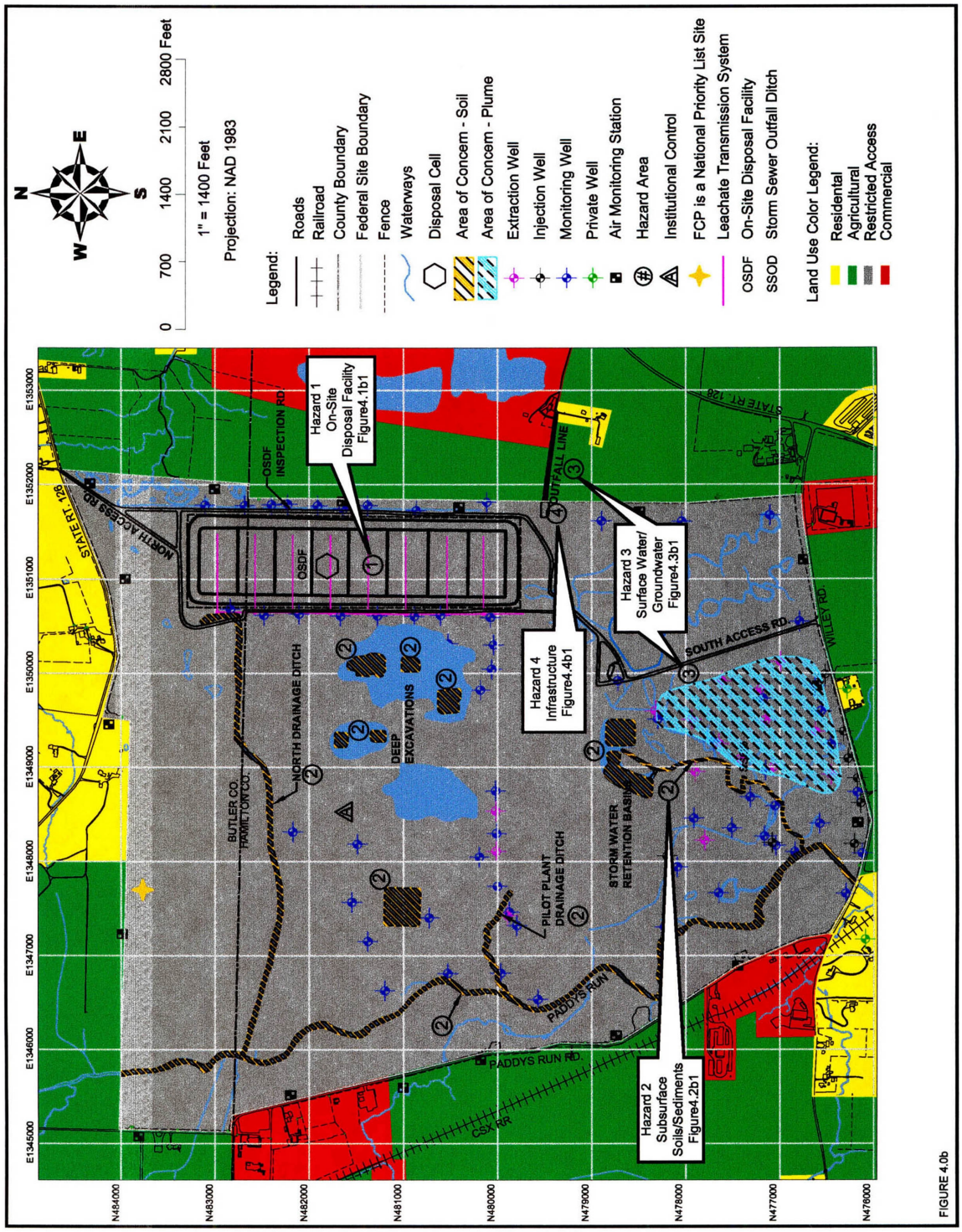


Figure 4.0b. Site wide hazard map – RBES.

4.1 HAZARD AREA 1 – ON-SITE DISPOSAL FACILITY

Background

Through Fernald's five RODs, it was decided that the site's smaller volume of more highly contaminated material will be disposed off site and the larger volume of material with low levels of contamination that can be safely contained will be disposed on site. The OSDF is a result of this "balanced approach" to waste management at Fernald. Excavated soil and debris will be disposed in the OSDF, or if it does not meet the on-site WAC, at an off-site disposal facility.

The OSDF WAC are derived from the FEMP RODs and from the OSDF remedial design requirements (for physical WAC and prohibited items). Although there are WAC concentrations for individual constituents, the WAC for total Uranium at 1,030 ppm is commonly cited since it is the predominant contaminant at the site and will drive most soil excavation (DOE, 1998). The WAC has been developed so that the OSDF will be protective at a risk level of 1 X 10^{-7} to an end-user of the FCP.

Combined with waste streams from other site remediation activities, a total of 2.5 million cubic yards of soil and debris will be placed in the OSDF. Approximately 85% of the material destined for the OSDF will be soil and soil-like material and the remaining 15% will be debris from the demolition of site buildings. In accordance with Fernald's RODs, the OSDF will only accept wastes from the Fernald Site. The primary material types destined for the OSDF include all contaminated in-place soil and soil stockpiles; the waste materials persent in the South Field, Active and Inactive Flyash Piles, the Lime Sludge Ponds, and the Solid Waste Landfill; and the debris resulting from sitewide facility decontamination and dismantlement (D&D) efforts .

RBES

The OSDF will be an eight-cell, 75-acre, fenced facility left on the FCP site after site closure (See Figure 4.1b1). The OSDF will be capped with an engineered cover. The liner will have leak detection and leachate collection and transmission systems. A buffer zone and perimeter fence will be established around the disposal facility. The OSDF and buffer zone will remain DOE property in perpetuity in order to allow DOE to continue maintenance and monitoring of the facility. In the event that DOE transfers management of the OSDF to another federal government entity, the appropriate restrictions and limitations will be communicated and implemented (e.g., deed restrictions). The OSDF fence will be maintained by DOE in perpetuity.

The OSDF WAC will be applied to materials with the consideration of the average WAC resulting from mixing within each cell. This practice was the original intent and basis of the WAC. The WAC of the OSDF will be applied by using contaminant-of-concern-specific average concentration within each cell; therefore, materials acceptance for disposal within the OSDF would be based on the overall average concentrations of contaminants within the cell meeting WAC instead of the not to exceed limits. The change in the application of the WAC will result in the OSDF being protective at a risk level of 1 x 10^{-5} which will continue to be fully protective of human health and the environment (See Figure 4.1b2).

All below WAC Resource Conversation and Recovery Act (RCRA) soil and the Silos debris will be disposed of in the OSDF.

The OSDF leachate with an approximate flow rate of 1 gallons per minute (gpm) will be discharged to surface water bodies in the former production area without further treatment as long as all the surface water FRLs are met. Directly discharging the OSDF leachate could contribute to an earlier removal of the Advanced Wastewater Treatment Facility.

The 1-gpm flow of leachate will not likely impact the overall ability of the surface water to meet FRLs so implementing the RBES Vision will continue to be fully protective of human health and the environment.

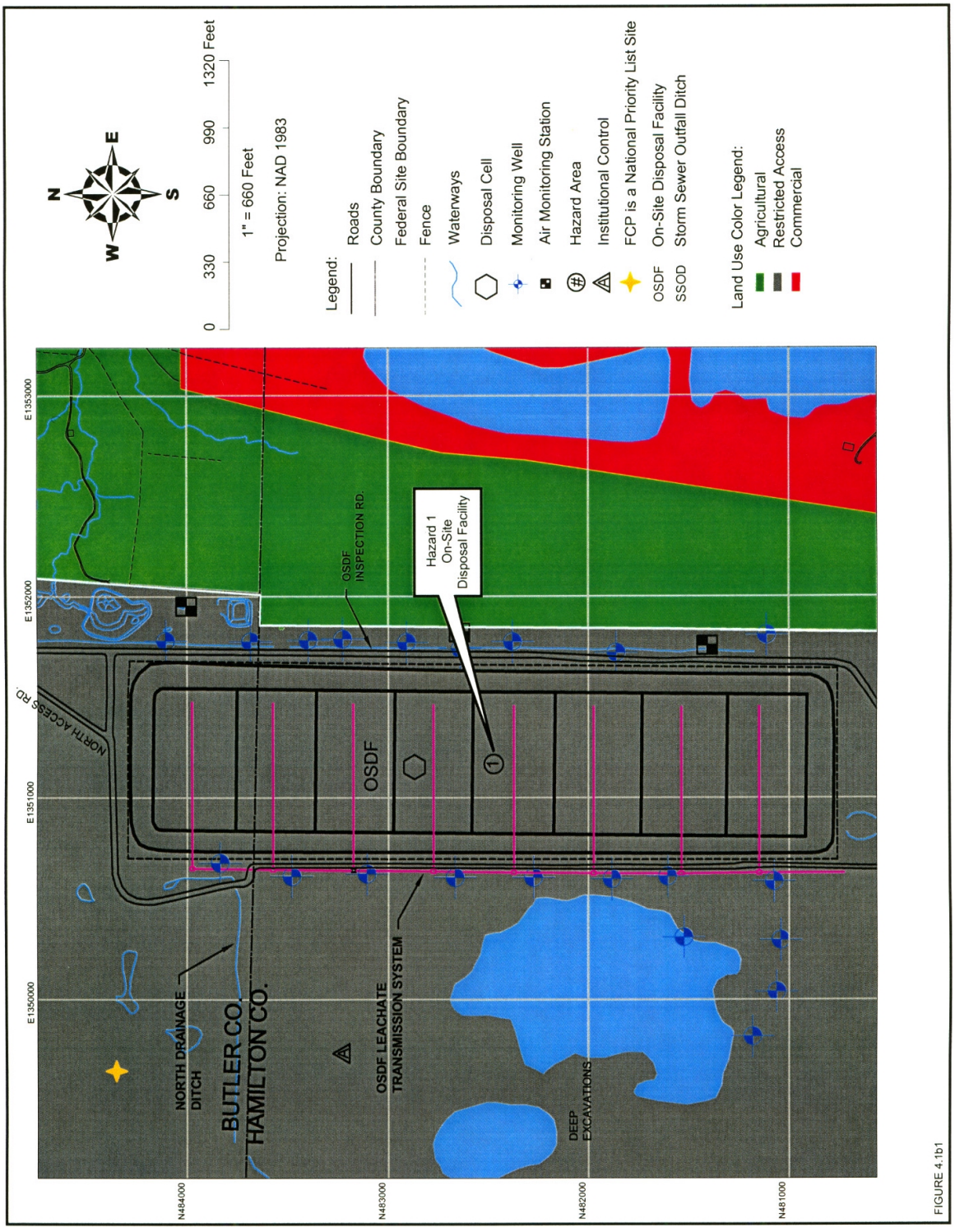


Figure 4.1b1. Hazard Area 1 OSDF map – RBES.

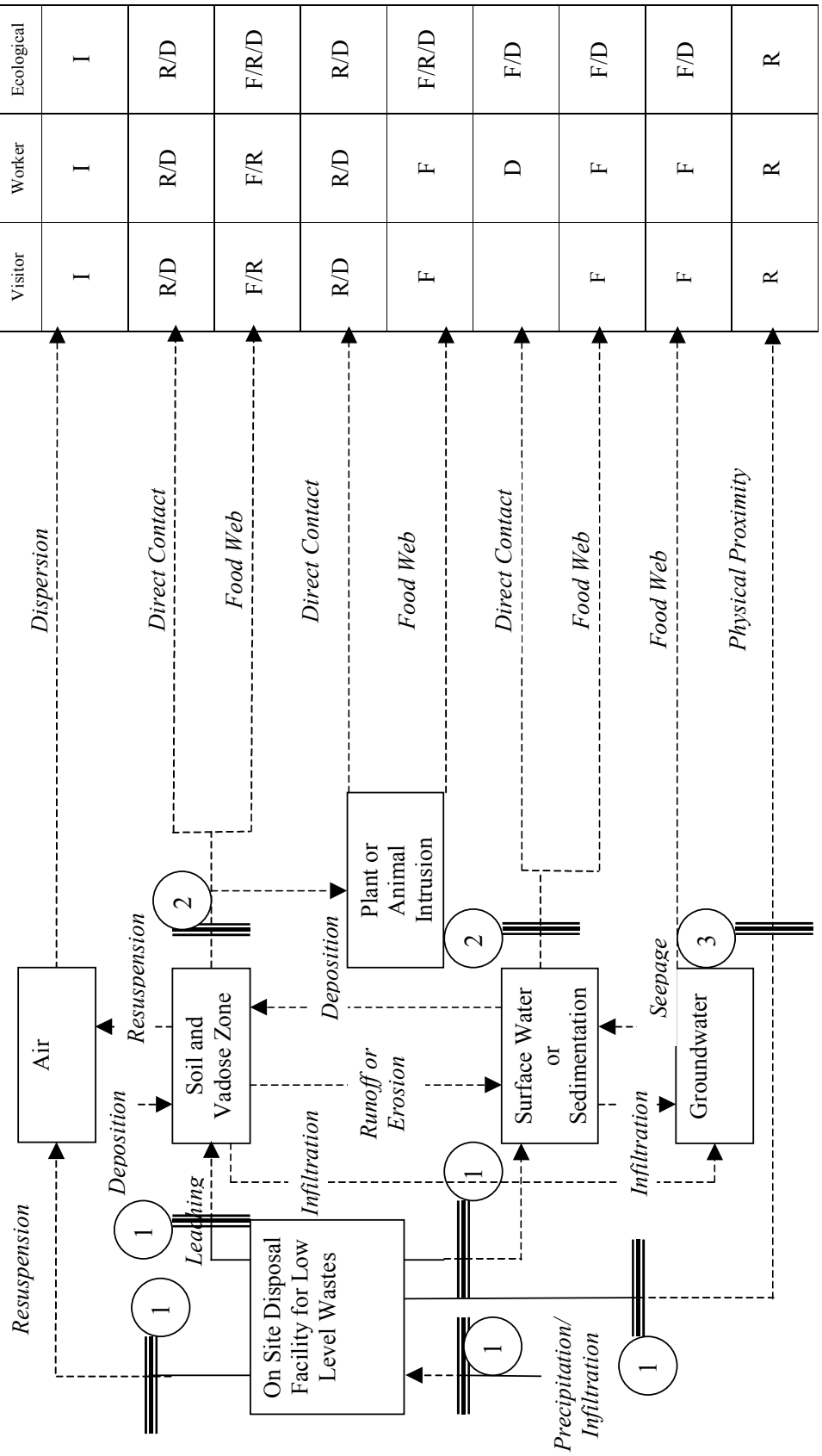
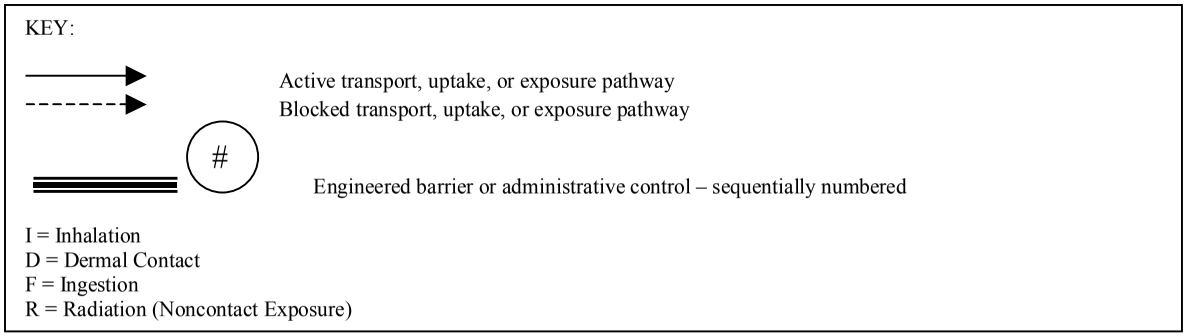


Figure 4.1b2. Hazard Area 1 OSDF CSM – RBES.



Narrative – Potential Release Mechanisms

This is a simplified conceptual model of potential environmental release mechanisms and exposure pathways for the OSDF containing soil, debris, concrete, metal with a high volume but low content of uranium, metals, and/or other long lasting contaminants. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The potential release mechanisms to the environment are (a) resuspension of contaminated particulate matter, (b) surface runoff, (c) leakage or leaching to subsurface soils from the facility, and (d) rupture of cap from settlement, plant intrusion, animal burrowing or erosion. Besides release through primary mechanisms, the contaminants introduced into the environment are likely to flow between different environmental media such as air, surface soil, surface water and groundwater due to interconnecting mechanisms such as runoff, deposition, infiltration, etc.

Based on these complex interconnecting transport mechanisms, potential human exposure mechanisms are: ingestion of plants grown using contaminated water; consumption of possibly contaminated fish and wildlife; direct contact with contaminated soils; possibly inhalation of resuspended particulate matter; and physical proximity to gamma emitting radionuclides. In addition to exposure pathways associated with environmental releases, direct exposure due to inadvertent intrusion is also considered as a significant hazard.

The potential ecological exposure mechanisms are likely to be ingestion of contaminated water, ingestion of plants grown using contaminated water, secondary ingestion of aquatic organisms that uptake contaminants through sediments or water, direct contact with contaminated soils, and inhalation of vapors or suspended particulate matter. There may also be a possibility of direct exposure to gamma emitting radionuclides due to inadvertent intrusion.

Narrative – RBES Barriers/Interventions

The steps taken to mitigate potential exposures are as follows:

1. The OSDF is constructed with a composite liner and cap of soil and geosynthesis. The liner has leak detection and leachate collection and transmission systems.
2. Periodic inspections and maintenance of the final cover will occur as well as periodic monitoring and maintenance of the leak detection system and groundwater monitoring system to ensure the protection of human health and the environment.
3. A buffer zone and perimeter fence will be established around the OSDF to restrict access to the public. The OSDF and buffer zone property will remain in DOE ownership in perpetuity. In the event that DOE transfers management of the OSDF to another federal government entity, the appropriate restrictions and limitations will be communicated and implemented (e.g., deed restrictions).

4.2 HAZARD AREA 2 – SUBSURFACE SOILS/SEDIMENTS

Background

Following 37 years of operations, air deposition, and waste disposal activities, Fernald soil and debris became contaminated with radionuclides and chemicals at levels that necessitated remediation. As required by the OU2 and OU5 RODs, contaminated soil above negotiated cleanup levels is being excavated. The site areas requiring excavation cover 400 acres and include the Lime Sludge Ponds, Southern Waste Units, and soil under the Waste Pits and Silos. Surface soil FRLs are being used for the remediation of all soil on the FCP (DOE, 1998). Excavated soils are properly disposed on site in the OSDF if they meet OSDF WAC or at an off-site disposal facility.

Surface soil FRLs were developed considering the potential for the inhalation of soil. The use of surface soil FRLs for streams, ponds and other open water areas is considered very conservative because the inhalation pathway will be eliminated or greatly reduced due to the ongoing presence of water. The use of sediment FRLs was contemplated in the ROD, but their specific application was not defined.

RBES

Sediment FRLs (210 ppm uranium) will be applied to all streams, ponds, and other excavations targeted for future ponds and open water (See Figure 4.2b1). Streams and ponds do not have the same exposure pathways as soil areas, due to water coverage.

The soil FRL takes into account the inhalation pathway and is therefore lower than the sediment FRL, which assumes no inhalation pathway. The ponds and open water will have permanent water coverage resulting in no change in risk, due to use of the sediment FRLs. Paddys Run does dry up in the late summer months, but controls (e.g., gates or ropes and signs) will be placed at access locations to keep people from utilizing the streambed in unallowable ways (e.g., motorcycles, ATVs).

Cross-Media Preliminary Remediation Goals (CPRGs) will be applied to subsurface soil instead of surface soil FRLs. This will reduce overall excavation of subsurface soils that have no surface exposure pathways. Soils removed during deep excavation of below grade structures will be segregated and used for backfill, as long as soil FRLs or CPRGs are met.

The use of the CPRGs will continue to be fully protective of the Recreational User of the site (See Figure 4.2b2). Any soil that meets CPRGs will be buried, eliminating the exposure pathway to any soil that is above soil FRLs.

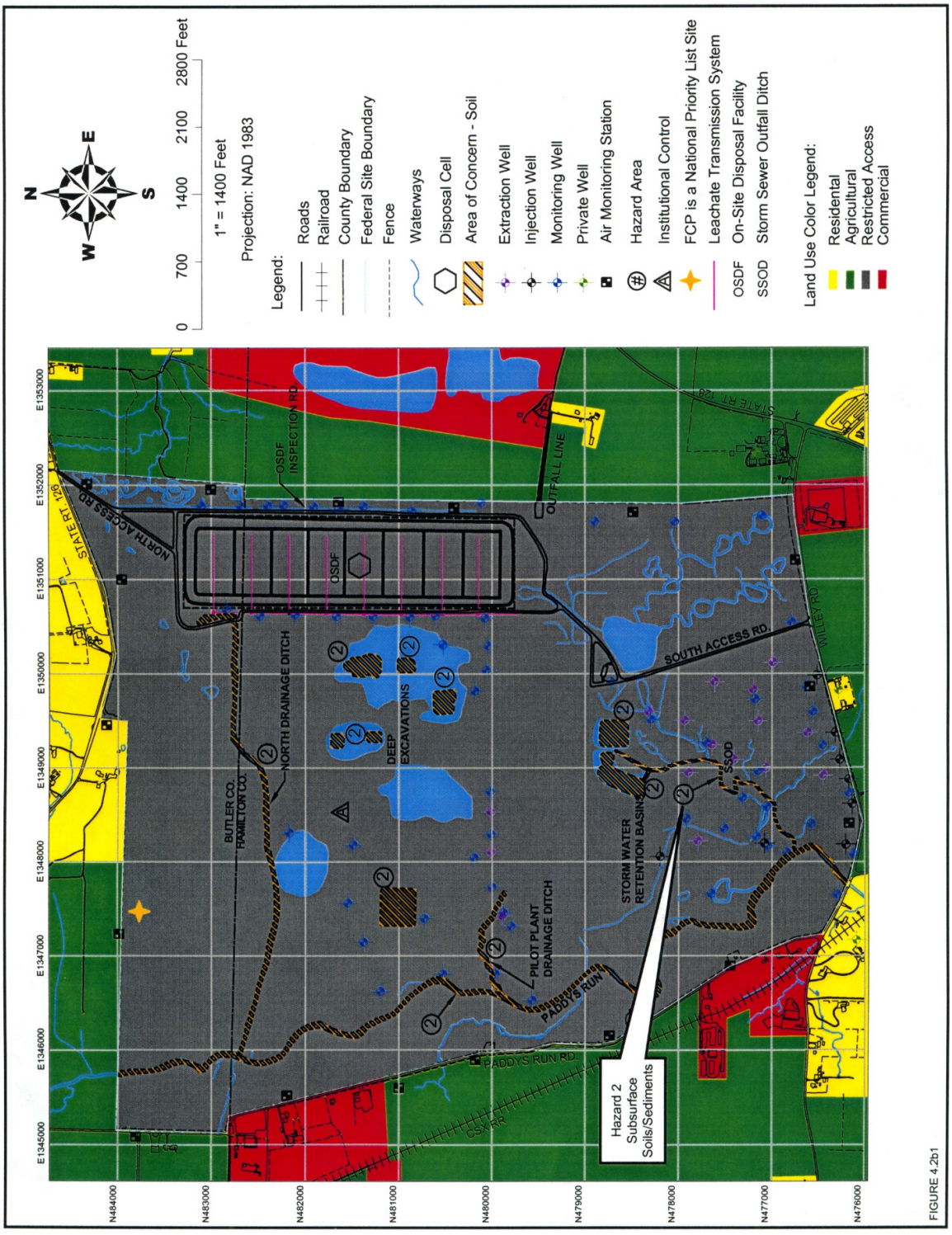


Figure 4.2b1. Hazard Area 2 subsurface soils/sediments map – RBES.

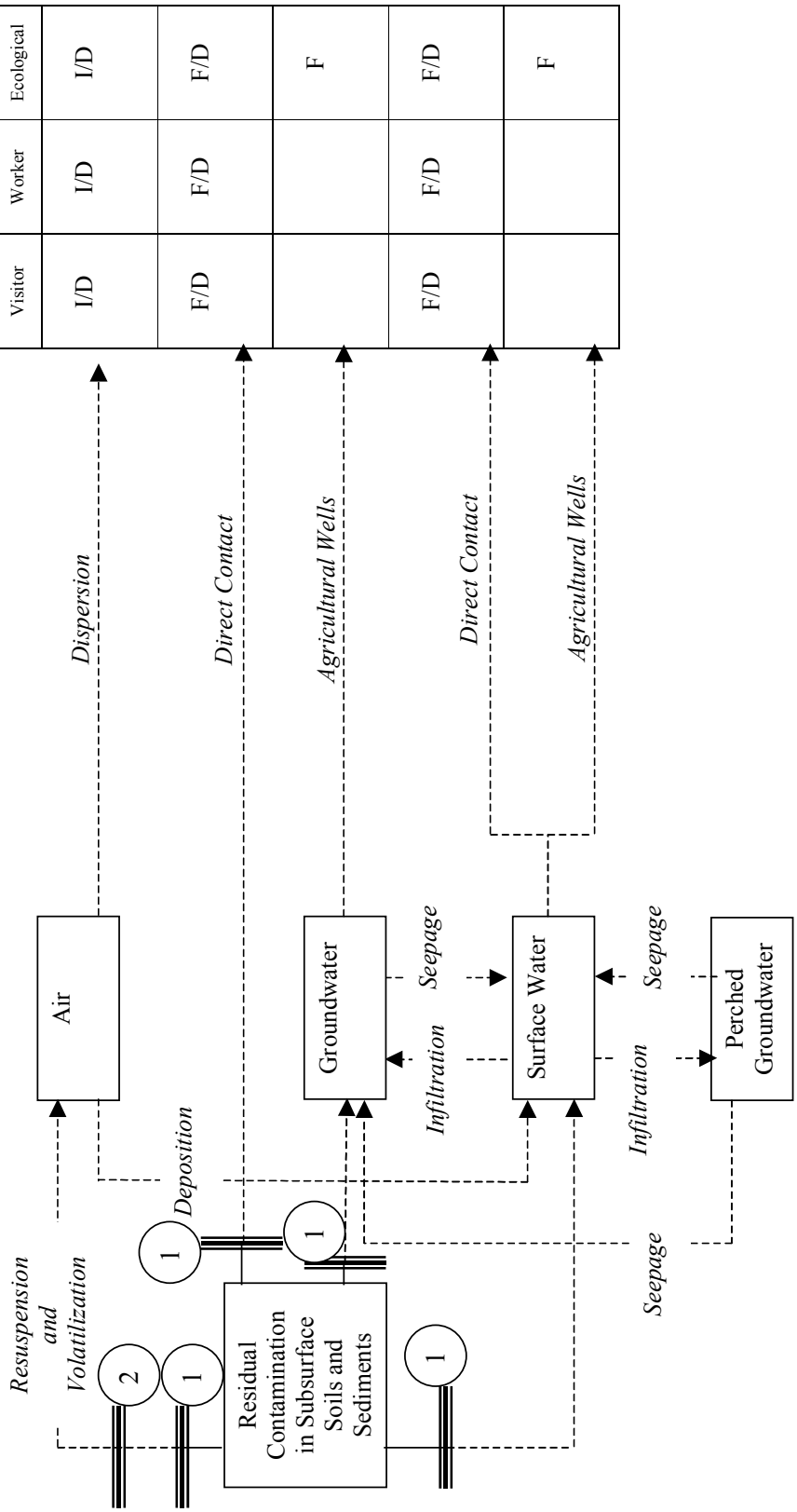
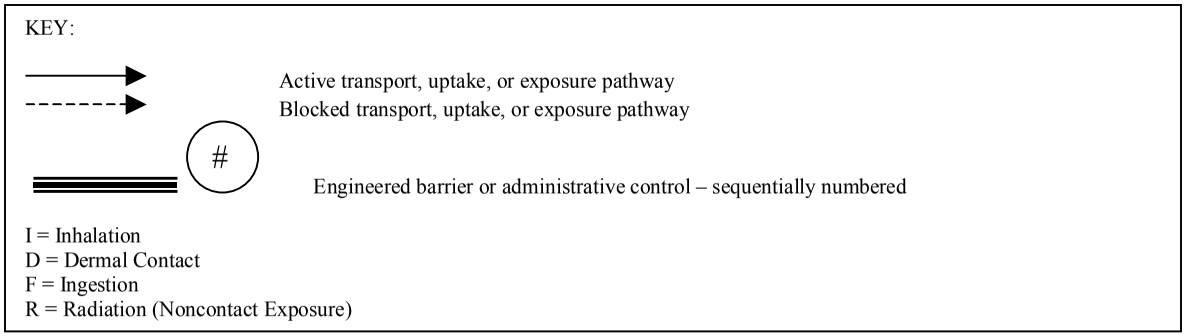


Figure 4.2b2. Hazard Area 2 subsurface soils/sediments CSM – RBES.



Narrative – Potential Release Mechanisms
This is a simplified conceptual model of the potential environmental transport and exposure pathways for residual contamination at Fernald. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The potential predominant release mechanisms to the environment are (a) resuspension of contaminated particulate matter, (b) volatilization of exposed chemical residuals, (c) erosion and surface runoff to surface water bodies, and (d) leaching of residual contamination into groundwater. No commercial, agricultural, or residential use of water is envisaged. Besides release through primary mechanisms, the contaminants introduced into the environment are likely to flow between different environmental media such as air, surface soil, surface water and groundwater due to interconnecting mechanisms such as runoff, deposition, infiltration, etc.

Based on these interconnecting transport mechanisms, potential human exposure mechanisms are: inhalation of volatilized vapors and resuspended particulate matter, and direct contact with contaminated soil or surface water. Groundskeepers, because they are at the site on a regular basis, would have the highest potential for exposure.

The ecological exposure mechanisms are likely to be inhalation of volatilized vapors and resuspended particulate matter, ingestion of contaminated water, ingestion of plants grown using contaminated water, secondary ingestion of aquatic organisms that uptake contaminants through sediments or water, direct contact with contaminated soils or water.

Narrative – RBES Barriers/Interventions
The steps taken to mitigate potential exposures are as follows:

1. Soils remaining in streams, ponds, and excavations targeted for future ponds and open water will meet the sediment FRL of 210 ppm uranium. Subsurface soils will meet CPRGs.
2. Sediments and subsurface soils are covered by water and surface soil, respectively; therefore, there is no pathway to air and no risk of exposure by inhalation.
3. Intervention - The FCP site will remain federal government property with limited public access for educational purposes.

4.3 HAZARD AREA 3 – SURFACE WATER/GROUNDWATER

Background

Fernald is located over the Great Miami Aquifer, one of the largest sources of drinking water in the nation. Following years of uranium production, the aquifer became contaminated with uranium. The levels of uranium in the groundwater are above the drinking water standard of 30 parts per billion (ppb) set by U.S. EPA. Through the Aquifer Restoration subproject, the contaminated portion of the aquifer will be restored by reducing the uranium concentration level to the drinking water standard.

The OU5 ROD documents DOE's commitment to restore the Great Miami Aquifer within 27 years (DOE, 1996b). The remedy is currently being accomplished by pumping the contaminated on-site and off-site groundwater plume from beneath 179 acres, and treatment at the Advanced Wastewater Treatment (AWWT) Facility until the combined, extracted groundwater is less than the ROD established discharge limits for uranium. These limits are 30 ppb on a monthly average and 600 pounds annually in the Site's effluent discharge to the Great Miami River. Although not required by the ROD, DOE is currently utilizing re-injection to enhance the remedy. The AWWT, with a combined groundwater and wastewater treatment capacity of approximately 2500 gpm, is projected to operate beyond the 2006 Closure date under the current state. Waste generated from the D&D of the AWWT and the remediation of the underlying soil will require off-site disposal under current plans.

Current groundwater modeling indicates that the groundwater FRL for uranium (30 ppb) would be achieved site wide by 2023, with the off-property portion of the South Plume falling below the FRL in 2013. The estimated life cycle cost for this alternative is $167.8 million with the estimated cost through the June 30, 2006 target closure date at $27.2 million (DOE, 2003b). Appendix C provides additional information regarding the complexities of the surface water/groundwater issues related to both the current state and the RBES remedy.

The Sitewide Ecological Risk Assessment (SERA) (DOE, 1995a) investigated risks to aquatic ecological receptors in the Great Miami River by comparing surface water contaminant concentrations to Benchmark Toxicity Valves (BTVs). This effort revealed that several Constituent of Ecological Concerns (COECs) warranted further investigation. The subsequent re-evaluation of ecological risks in the Sitewide Excavation Plan (SEP) concluded that three parameters (barium, cadmium, and silver) should be added to the IEMP surface water sampling program (DOE, 1998). Results of this effort have revealed that of 359 samples, only six BTV exceedances have occurred since 1997. Five of the six exceedances were for cadmium, which has a BTV lower than the Great Miami River background concentration. DOE and USEPA/OEPA subsequently agreed to eliminate most BTV-driven surface water sampling due to the extremely limited number of exceedances. Therefore, surface water COECs in the Great Miami River are not an issue.

RBES

Full restoration of the aquifer, to meet the uranium drinking water standard of 30 parts per billion (ppb), would occur both on-site and off-site. The AWWT facility will be shut down, undergo D&D, and be disposed of in the OSDF, along with the underlying, impacted soil, by Site Closure.

The most cost-effective infrastructure to support groundwater remediation post 2006 closure will be identified and installed to replace the AWWT. Treatment capability and capacity is envisioned to be provided in a smaller, modular facility (approximately 800 – 1000 gpm) to handle remediation wastewater streams (e.g., impacted storm water and OSDF leachate) and groundwater treatment after the AWWT is shut down. This alternate treatment would not require formal changes to the OU 5 ROD or

associated regulatory permits. Discharge limits would be accomplished primarily by adjusting groundwater pumping rates when necessary and terminating groundwater re-injection without significantly delaying the aquifer restoration time frame. Based on the observed progress of aquifer restoration, it is expected that no significant change in the groundwater remediation schedule would occur under the conceptual RBES remedy.

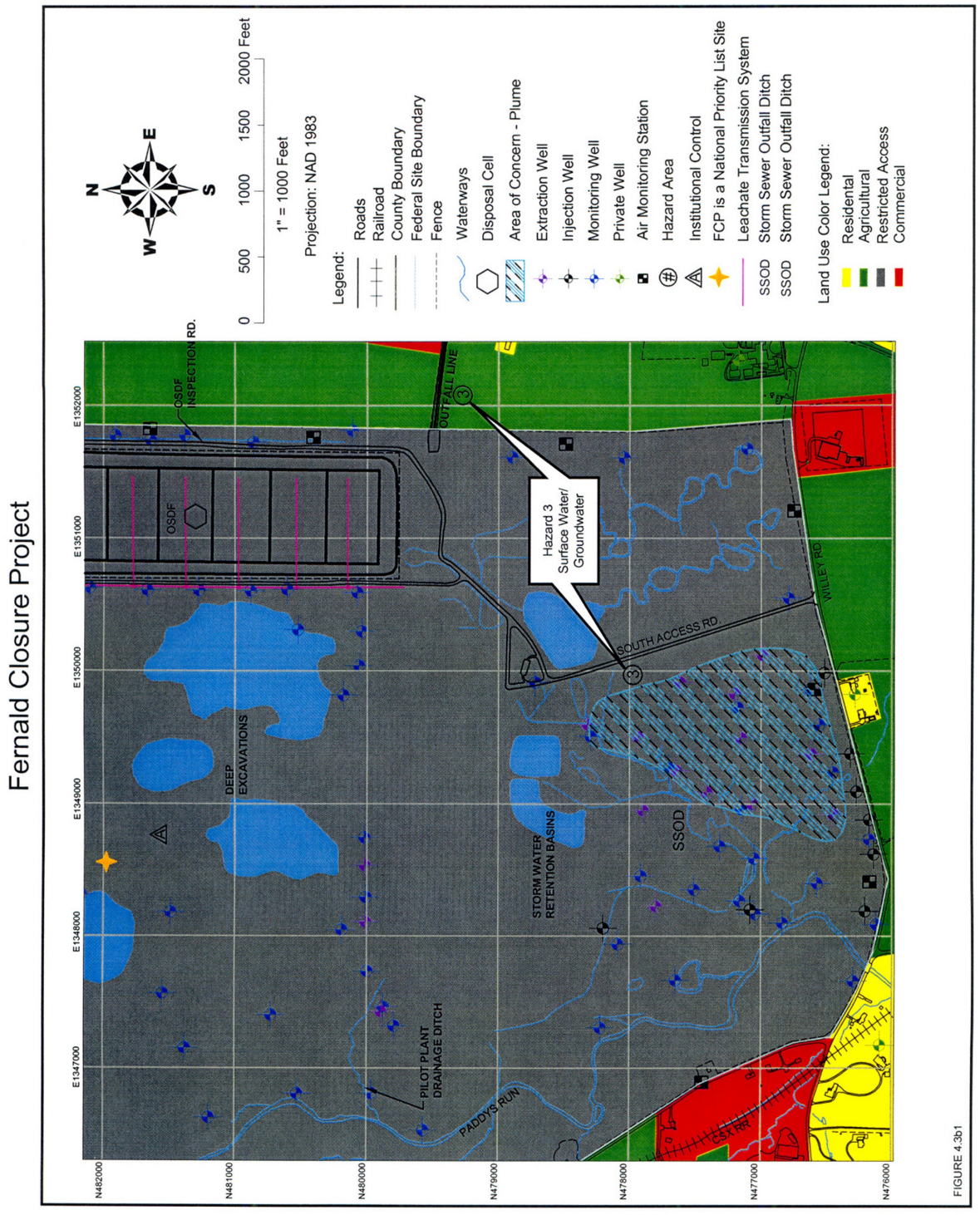


Figure 4.3b1. Hazard Area 3 surface water/groundwater map – RBES.

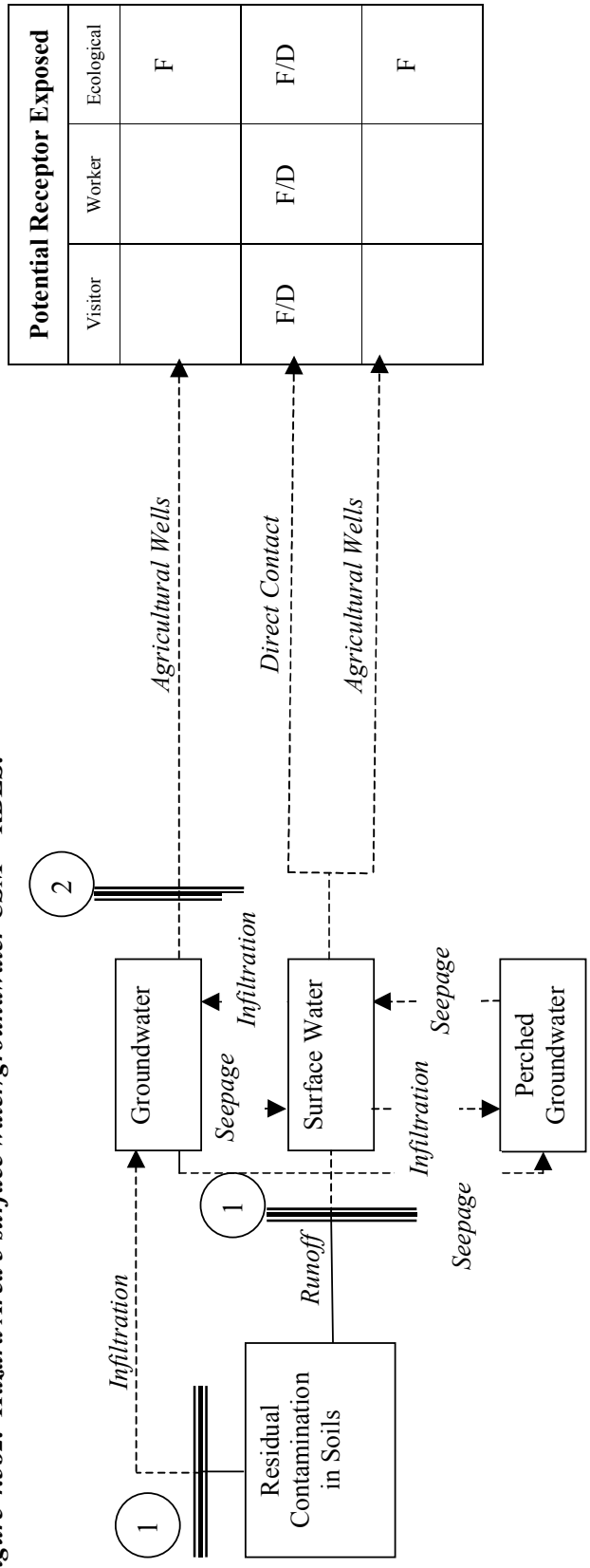
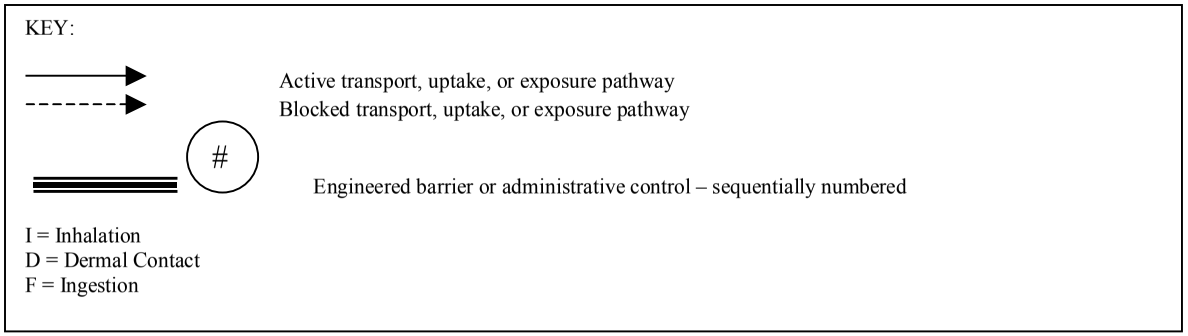


Figure 4.3b2. Hazard Area 3 surface water/groundwater CSM – RBES.



Narrative – Potential Release Mechanisms
This is a simplified conceptual model of potential environmental transport and exposure pathways for uranium contaminated surface water and groundwater. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The primary source of contamination to the surface water and groundwater is the residual contamination in the soils. Treatment of the groundwater plume will consist of pumping the existing extraction wells, blending the flows from the wells with untreated storm water and remediation wastewater, and discharging the blended flow to the Great Miami River. Discharging will continue until the plume has met groundwater FRLs.

The potential predominant release mechanisms of contaminants in wastewaters to the environment are (a) infiltration of surface water to groundwater and perched groundwater and (b) seepage from perched groundwater to surface water, perched groundwater to groundwater, and groundwater to surface water.

The potential exposure mechanism to the Recreational User is direct contact with and ingestion of surface water.

The potential exposure mechanism to ecological receptors is ingestion of contaminated well water and direct contact with surface water.

Narrative – RBES Barriers/Interventions
The steps taken to mitigate potential exposures are as follows:

1. Monitoring of the discharge stream to the Great Miami River will continue to ensure that the stream meets the ROD based discharge limits.
2. Use of contaminated groundwater off site will be prohibited until the plume meets the U.S. EPA Drinking Water Standard for uranium of 30 ppb.
3. Intervention - The FCP site will remain federal government property with limited public access for educational purposes.

4.4 HAZARD AREA 4 – INFRASTRUCTURE

Background

The OU2 and OU5 RODs require the excavation of contaminated soil above negotiated cleanup levels. The site areas requiring excavation cover 400 acres. In addition to contaminated soil, building foundations, concrete storage pads, parking lots, roads, and below-grade piping will be removed as part of soil excavation.

RBES

The outfall lines to the Great Miami River, the cofferdam, and other structures at the Great Miami River will be left in place (See Figure 4.4b1).

The old outfall line will be grouted in place. The outfall line is a cast iron pipe that runs approximately 0.66 miles from the FCP to the Great Miami River. Removing the old out fall line would require extensive excavation of surrounding land and removal and replacement of State Route 128 resulting in the obstruction of traffic.

The new outfall line will be cleaned and abandoned in place. The new outfall line is constructed of high-density polyethylene (HDPE) and can be cleaned on the inside to eliminate the risk of contaminants leaching into surrounding soils. Abandoning it in place will save construction costs associated with excavation of the lines.

Implementing the RBES Vision will continue to be fully protective to human health and the environment (See Figure 4.4b2).

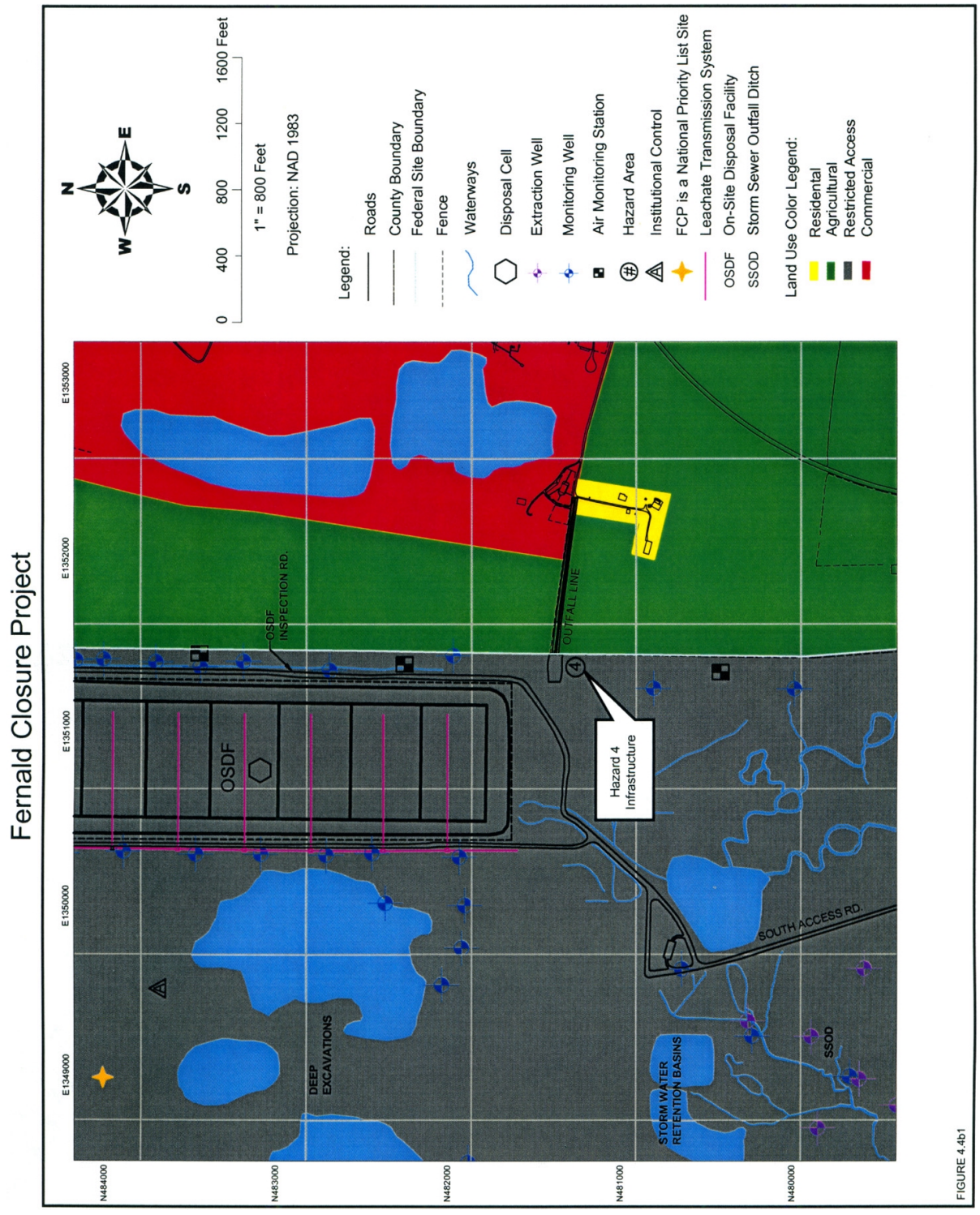


Figure 4.4b1. Hazard Area 4 infrastructure map – RBES.

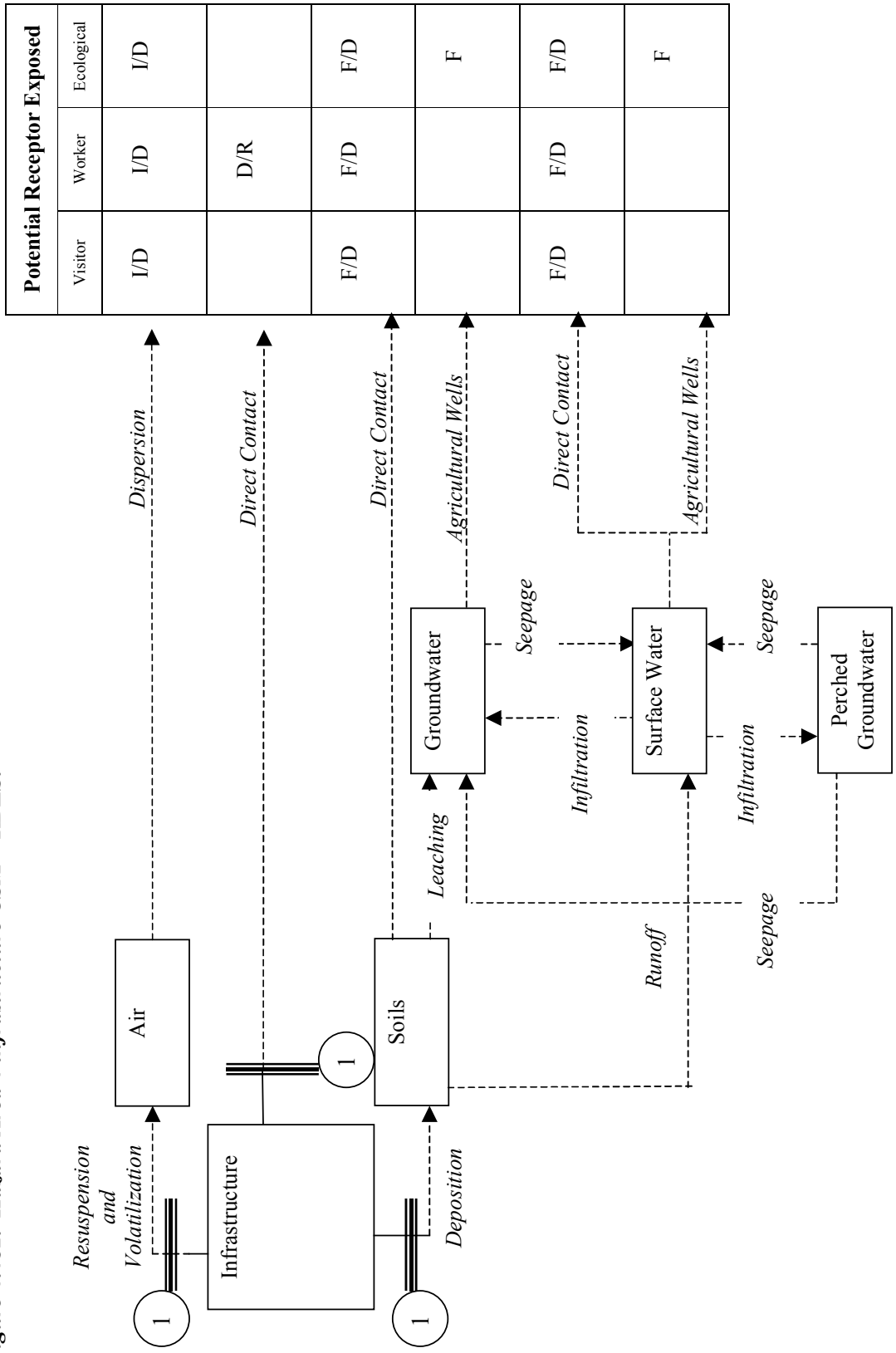
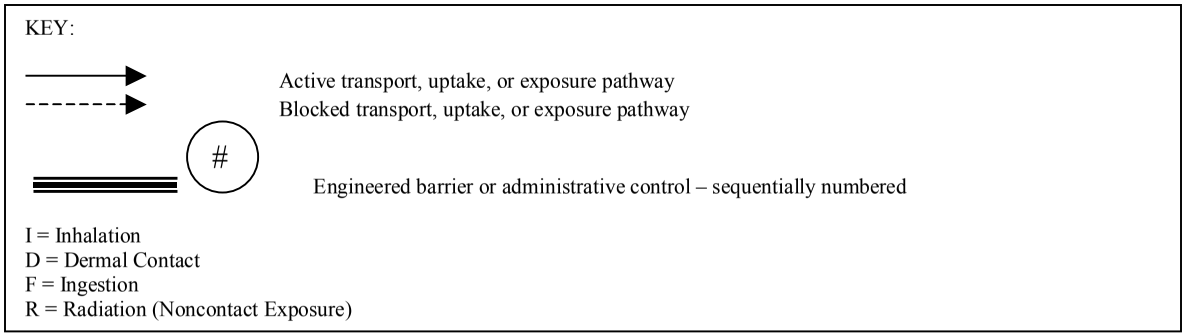


Figure 4.4b2. Hazard Area 4 infrastructure CSM – RBES.



Narrative – Potential Release Mechanisms
This is a simplified conceptual model of the potential environmental transport and exposure pathways for infrastructure left on site. The outfall lines, cofferdam, and other structures at the Great Miami River will be abandoned in place. Institutional controls will ensure that the outfall lines are not excavated or removed. While no release to the environment is assumed, this model considers potential release and exposure pathways.

The potential predominant release mechanisms to the environment are (a) resuspension of contaminated particulate matter, (b) volatilization of exposed chemical residuals, and (c) deposition of contaminants to the surrounding soil. Besides release through primary mechanisms, the contaminants introduced into the environment are likely to flow between different environmental media such as air, surface soil, surface water and groundwater due to interconnecting mechanisms such as runoff, deposition, infiltration, etc.

Based on these interconnecting transport mechanisms, potential human exposure mechanisms are: inhalation of volatilized vapors and resuspended particulate matter, and direct contact with contaminated soil or surface water. Groundskeepers, because they are at the site on a regular basis, would have the highest potential for exposure.

The ecological exposure mechanisms are likely to be inhalation of volatilized vapors and resuspended particulate matter, ingestion of contaminated water, ingestion of plants grown using contaminated water, secondary ingestion of aquatic organisms that uptake contaminants through sediments or water, direct contact with contaminated soils or water.

Narrative – RBES Barriers/Interventions
The steps taken to mitigate potential exposures are as follows:

1. The old outfall line and unnecessary wells (recovery, injection, and monitoring) will be grouted to contain contaminants and the new outfall line will be cleaned.
2. Intervention - The FCP site will remain federal government property with limited public access for educational purposes.

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* = Includes Baseline Risk Assessment

** = Includes Evaluation of Ecological Constituents of Concern